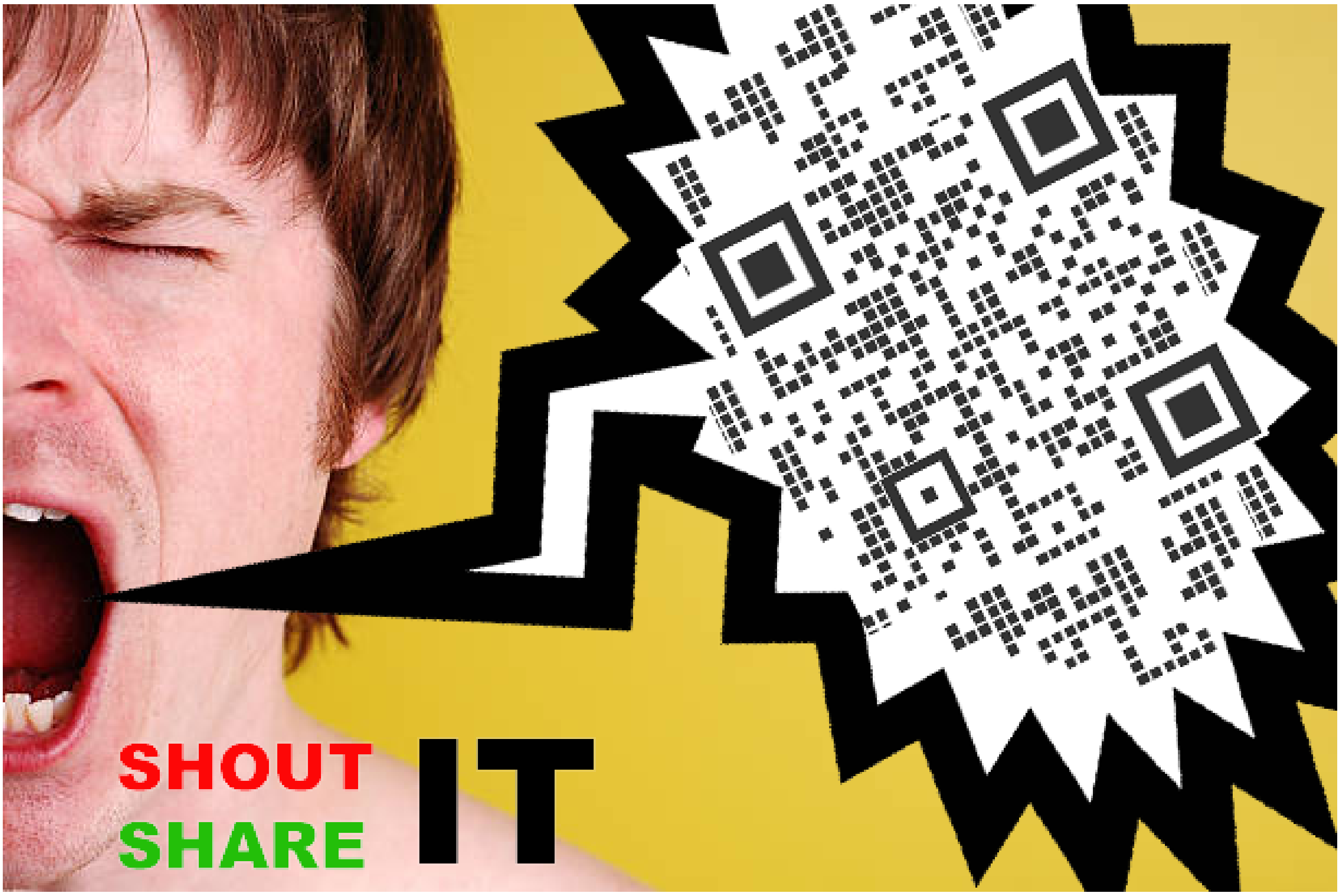
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BULLETIN NO. 12.
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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

NEW YORK
BOTANICAL
GARDEN.

A REPORT
UPON THE
GRASSES AND FORAGE PLANTS
AND
FORAGE CONDITIONS
OF THE
EASTERN ROCKY MOUNTAIN REGION.

BY

THOMAS A. WILLIAMS,
ASSISTANT AGROSTOLOGIST.

PREPARED UNDER THE DIRECTION OF THE AGROSTOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., April 23, 1898.

Sir: I have the honor to transmit herewith, and recommend for publication as Bulletin No. 12 of this Division, a report upon the grasses and forage plants and forage conditions of the eastern Rocky Mountain region, by Thomas A. Williams, assistant agrostologist. Field agents of the division have been carrying on investigations in the region embraced in this report during the past three years, and Mr. Williams, of the division staff, has visited, during the seasons of 1896 and 1897, the more important grazing districts, where, under the direction of the Agrostologist, he has studied the present forage problems of the region and investigated the native grasses and forage plants, noting their characteristics, distribution, general prevalence, and economic importance; he has endeavored to ascertain how the most desirable sorts may be preserved or increased, and has also made close personal observations with the view of determining some practical means of restoring the ranges to their original grazing value, or at least preserving them from further injury through careless and short-sighted practices. The present report is based upon these studies and investigations, as well as upon the results of work done by the field agents of the division. While carrying on these investigations the work of the field agents has not been confined to the districts easily accessible from the railroads and other common lines of travel, but, by means of wagon trips and side excursions on horseback, they have penetrated into the less-known localities, in every case making extensive collections of specimens and seeds, as well as obtaining all the data possible relating to the question of forage supply. One field agent thus covered nearly 1,000 miles in a wagon trip of two months during the past season. (See fig. 1.) There has also been included much valuable information acquired through correspondence with prominent citizens and leading stockmen, who have most cordially responded to letters of inquiry relative to the matters in question and materially aided the Department in the prosecution of these grass and forage-plant investigations. Hearty thanks are here expressed to all those correspondents who have thus cooperated in the work of the division.

Some idea of the importance of the subject of this Report upon the Grasses and Forage Plants and Forage Conditions of the Eastern Rocky Mountain Region is indicated by the following statements:

It is estimated from Report No. 7, Division of Statistics, that in the State of Wyoming about 15,000,000 acres are taken up by mountains and forest areas, about 10,000,000 acres are irrigable and hence suitable for general agriculture, while nearly 40,000,000 acres, or almost two-thirds of the entire State, may be regarded as pasture lands only. In Montana the proportion of pasture lands is fully as great as in Wyoming, while in Colorado it will probably fall but little below.

At the beginning of the year 1897 there were in these three States about 350,000 head of horses and mules, valued at about $9,000,000, over 3,000,000 head of cattle, valued at nearly $56,000,000, and over 6,200,000 head of sheep, valued at over $10,500,000, or a total valuation for the stock supported chiefly by these native pasture and meadow lands of about $75,500,000.

The first report on the investigations of the forage plants of the Northwest, from this division, was Bulletin No. 5, on the Grasses and Forage Plants of the Rocky Mountain Region, by P. A. Rydberg and C. L. Shear. This was followed by Bulletin No. 6, on the Grasses and Forage Plants of the Dakotas, by T. A. Williams, aided by Prof. M. A. Brannon, of North Dakota, and E. N. Wilcox and David Griffiths, of South Dakota. Embracing much the same field is Prof. L. H. Pammel's Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado, published as Bulletin No. 9 of this Division; and another, on The Red Desert of Wyoming and its Forage Resources, by Prof. Aven Nelson, is now in press. In the present bulletin the topographical features of the region are considered, including a discussion of the soil, water supply, etc. This is followed by detailed accounts of the cultivated grasses and forage plants and the more important forage plants, both grasses and species of other families, native to the region, concluding with suggestions on methods of improvement of the forage conditions of the ranges.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

HON. JAMES WILSON,
Secretary of Agriculture.

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A REPORT UPON THE GRASSES AND FORAGE PLANTS AND FORAGE CONDITIONS OF THE EASTERN ROCKY MOUNTAIN REGION.

INTRODUCTION.

Stock raising will always be an important industry in the vast expanse of territory lying between the Rocky Mountains and the one-hundredth meridian. The early settlers recognized its many natural advantages for this purpose, and at once began to cover the hills and valleys with cattle and other stock. Under the stimulating influence of high prices, resulting largely from the demand created by the civil war, stock raising rapidly grew to be an industry of immense proportions. At first forage was plentiful; everywhere the supply seemed inexhaustible, and the ranchman's chief concern was to get more stock in order that he might turn into cash the grasses of the prairies. Stock grew and fattened on no other feed than the native grasses throughout the entire year.

At length, however, stockmen became aware of the fact that not only was there a possibility, but a probability, that the supply of forage would soon be exhausted if they continued to follow the old methods of stock raising. Under this old system of mismanagement the ranges were stocked to their utmost capacity, even for the most favorable conditions, and consequently the past series of dry seasons resulted in a great shortage of feed. Ranchmen are already confronted with the necessity of providing extra forage supplies for use in seasons when the grasses on the range are short.

With a view to finding some practical means of bettering existing conditions and encouraging stockmen in their efforts to grow forage crops, a series of investigations of the various forage problems existing in the West and Northwest, particularly in the States of Montana, Wyoming, and Colorado, is being carried on by the direction of the Secretary of Agriculture through the Division of Agrostology. These investigations are designed to secure full and accurate information regarding the present condition of the forage problem; what the greatest needs are, and how they can be met in the most practical manner; to study the native grasses and forage plants, their characteristics, distribution, abundance, and value; to ascertain the best means of preserving the more desirable sorts, and to introduce into cultivation such as promise to be of value; to devise some practical treatment for the ranges which will not only restore their original grazing value but guard against future injury through overstocking and other careless and shortsighted practices.

The information upon which this report is based has been gathered from various sources. During the past three seasons field agents of the division have been working in the different parts of the region in question studying matters pertaining to the forage supply. The writer has made two trips into the more important grazing districts, and, under the direction of the chief of the division, has studied the conditions and needs by consulting with the stockmen and collecting all facts likely to aid in the work of getting at a practical solution of the various forage problems confronting the people at the present time, and thereby laying the foundations for more intelligent and economical practices in the future.

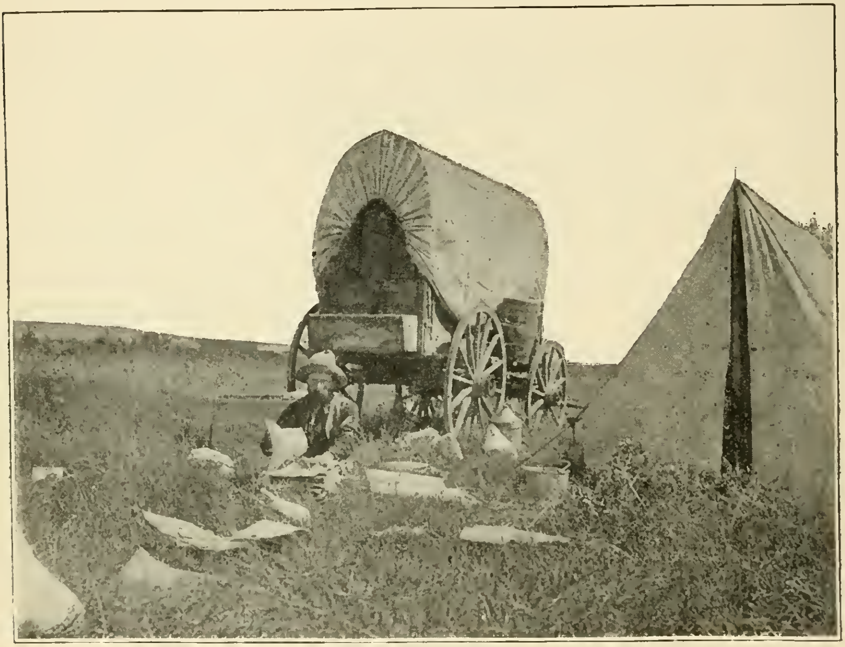

FIG. 1.—In the field.

In April, 1897, the following circular letter with the appended questions was sent to prominent stockmen, farmers, and others interested in the forage problem:

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., April, 1897.

DEAR SIR: Under the direction of the Secretary of Agriculture this division is investigating the forage question in the Northwest, particularly in the States of Montana, Colorado, and Wyoming. In this investigation particular attention is being given to the native grasses and forage plants, their characteristics, distribution, abundance, and value; the best means of preserving the more valuable kinds, and the methods to be employed in reclaiming those ranges which have been rendered of little or no value for grazing, through overstocking or other causes. In order to obtain a more definite idea as to what the present conditions and greatest needs are, and to gain all possible information that will aid us in determining the most practical methods of improving these conditions, by the introduction and cultivation of new grasses and forage plants or by the preservation and cultivation of native species, correspondence is hereby invited with all interested in the development and preservation of the stock-raising and dairying industries.

There are over 225 different grasses native to this region, and it would be difficult to give an adequate estimate of their immense value as a natural resource. Ever since the Northwest has been settled these grasses have been the chief source of food for the many thousands of horses, cattle, and sheep raised there, and many of them will undoubtedly prove more valuable under cultivation than they are in the native state.

Any assistance you may render in this undertaking, either by sending us the names and addresses of leading farmers, stock raisers, and dairymen of your region, or by furnishing information relative to the points above indicated, will be highly appreciated

Yours, truly,
F. LAMSON-SCRIBNER,
Agrostologist.

Approved:
JAMES WILSON,
Secretary of Agriculture.

(1) What is the chief forage problem in your section—that is, do you need hay plants, soiling crops, drought-resistant crops, winter forage, or early spring or late autumn forage?

(2) How many head of cattle, horses, or sheep can be safely pastured to the square mile under existing conditions?

(3) Has the stock-carrying capacity of the ranges and pastures in your section been diminished through overstocking or other causes? If so, to what extent?

(4) What treatment do you recommend for restoring, renewing, and improving the ranges where they have been overstocked?

(5) What are the most highly valued native grasses and forage plants, and are there any tame grasses or forage plants which might be profitably introduced on the ranges to take the place of the valuable wild grasses of former years?

(6) What is the general character of the land in your locality, and what grasses flourish best on it?

Answers were received from about 600 persons, and the following may be taken as representative of the ideas expressed by the great majority of them.

From Governor Robert B. Smith, of Montana, the following answers were received:

(1) We need drought-resistant crops and winter forage.

(2) Fifty head of horses or cattle or 250 sheep.

(3) Where sheep range, destroyed at least one-half.

(4) If sheep were compelled to be kept in certain portions of the range and the remainder left free for cattle or horses, the range would be fully restored in three years. Sheep destroy the range; cattle and horses do not.

(5) Blue-joint and buffalo-grass are the best native grasses. Do not know of any tame grasses to take their places.

(6) Light gravelly land; soil not deep but rich, and with large per cent of alkali. Buffalo-grass and blue-joint flourish best.

From Hon. John C. Bell, M. C., of Colorado:

(1) In the Uncompahgre, Gunnison, and Grand valleys, the San Luis Valley, and the upper portion of the Arkansas Valley, our great field plant is alfalfa. The mountain sides, mesas, and foothills are covered with bunch grass which supplies all herds from about April 1 to December 1. If we could find some grass that would flourish in the low foothills without irrigation for winter feed it would be a great boon to all of Colorado. Our summer forage is ample and of the very best quality.

(2) The ranges vary so that no approximate estimate can be made. On some high mesas where the snow is deep in winter the grass is very abundant, but lower down it decreases. But these ranges are ample for all the stock that can be wintered in the valleys below.

(3) Not in the mountainous regions.

(4) Cattle and horses rarely impoverish a range, as they do not feed in close bunches, but sheep tramp out and practically destroy the grasses wherever they are kept. Horses and cattle will not remain or feed with them on the range.

(5) Bunch-grass and blue-stem in the mountain regions can not be surpassed unless some grass could be found that would stand the drought in the foothills.

(6) We have three varieties—adobe, black loam soil on the river bottoms, and the high "red oxide" mesa lands. Vegetables grow best on the black loam, wheat and oats on the adobe, fruit trees and alfalfa on the high mesa, though it is all better than the average lands of the country for any of the ordinary crops, and would probably produce most of the common grasses, though but little experiment has been made in this direction.

From Hon. Jos. M. Carey, Cheyenne, Wyo.:

(1) The introduction of a forage plant that will mature during our short seasons and will afford good grazing all the year, the seed of which would germinate and grow by simply being raked or "disked in" on the native sod. The native grasses are so valuable that it would be unwise to destroy them, but with nutritious grasses to supplement them the capacity of a given section for grazing purposes might be greatly increased.

(2) This depends upon circumstances. Some sections as they were left by nature would scarcely carry an animal; others, 30 to 40 head. Should say average 15 head for three hundred and sixty-five days.

(3) Yes; but as soon as cattle are removed the ranges again grow up to the native grasses. When I speak of cattle I mean neat cattle and horses. Where sheep graze for a number of years weeds take the place of native grasses.

(4) Rest.

(5) Bunch-grass, blue-stem, and buffalo-grass are the varieties best known to stockmen. I do not know of any.

(6) Sod free from brush of any kind. The native grasses referred to; with irrigation all of the small grains and forage plants that are common in this latitude produce well. Alfalfa does well everywhere in this State when irrigated, where the altitude is not over 5,000 feet. Three crops may be harvested; season's production, from 3 to 6 tons an acre.

A glance through this correspondence shows at once that not one but many problems relating to the forage supply demand attention. Localities having like soil and climatic conditions may still differ widely as to the most pressing needs. Thus, in one locality the greatest need may be early spring forage, in another it may be winter forage, and in still another it may be summer feed, while in many localities it is a question of a general shortage for the entire year.

The study of the forage question in the West and Northwest has not been carried far enough to give us solutions to all the problems confronting the stockman, but it has been sufficient to reveal pretty clearly the causes that have led up to the present exhausted condition of the range. It shows that the past methods of handling the range have been shortsighted, and that while these practices are being in a measure corrected by the natural course of events, it is imperative that steps should be taken to restore and preserve the productiveness of the native meadow and pasture lands before the destruction has gone too far. The improvement in the native forage noticeable in some localities during the past one or two seasons is likely to be but temporary, as already stockmen in these localities are trying to increase their herds, and the lands will soon be overstocked again.

The investigation has also resulted in a large amount of valuable data regarding the native grasses and forage plants, the wealth of species found in the region, their value in the natural condition, and their possibilities under cultivation. There can scarcely be any doubt that some of these native forms will ultimately become as valuable for general cultivation as many of the so-called "tame" sorts.

GENERAL TOPOGRAPHICAL FEATURES OF THE REGION.

The topographical features of the three States comprising the greater part of the Eastern Rocky Mountain region are, in many respects, very similar. The continental divide, which traverses Montana about 100 miles east of the western boundary and nearly parallel with it, enters Wyoming a little to the southward of the northwestern corner of that State and continues its general trend to the southeast until it reaches central Colorado, where it turns rather abruptly to the southwest. Approximately five-sixths of Montana, three-fourths of Wyoming, and two-thirds of Colorado lie east of this divide. While in each State the greater part of the mountain area is found in the immediate vicinity of this divide, numerous outlying ranges occur which exert a great influence, not only upon the physical character of the country, but also upon the climatic conditions, particularly in the distribution of the moisture; as, for example, the Big and Little Belt Mountains, Snow Mountains, Bears Paw Mountains in Montana, Shoshone Mountains, Big Horn Mountains, Bear Lodge Mountains, and Laramie Mountains, in Wyoming, and the Sangre de Cristo and other ranges in Colorado.

In most cases the mountains along the main divide are rugged, with precipitous sides, more or less thickly covered with timber, which is chiefly evergreen, or coniferous. Sometimes the forest covering is so heavy that the growth of grasses is very limited, but usually there are numerous "parks" or "opens," in which flourish certain grasses and other forage plants. The slopes of the mountain ranges are cut up by numerous gulches and canyons, through which flow streams of water, fed largely by the melting snows on the mountain tops. The valleys of these streams widen out here and there into grass-covered areas of various sizes, forming the "mountain meadows" for which this region is justly famous. The valleys of many of the larger mountain streams, uniting with those of their more important tributaries, often form areas of considerable extent, in which, because of the rich soil and abundant supply of moisture, luxuriant growths of native grasses are produced. These areas, variously called "basins," "parks," etc., protected as they are by mountains on all sides and provided with an abundance of excellent forage and pure water, are magnificent natural pastures, whose only drawback is that often the altitude is so high and the snowfall is so great that they can be used for only a limited portion of the year. (See fig. 2.) Excellent examples of these areas are Spanish Creek basin, in southern Montana; Centennial Valley, at the head of the Little Laramie River, in Wyoming, and the numerous "parks" of Colorado.

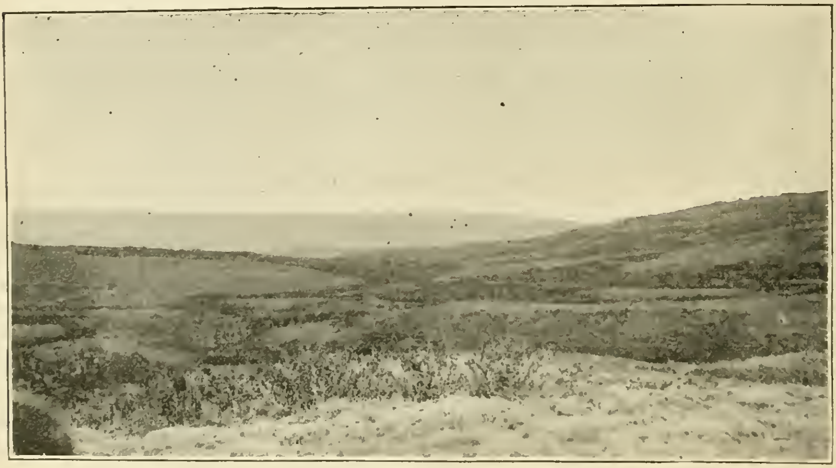

FIG. 2.—The ideal summer range. (From photograph by Prof. A. Nelson.)

In some of the outlying ranges the mountains are less rugged, the slopes are often but sparsely or not at all wooded, and hence offer proportionately larger forage producing areas. For example, the Big Horn and Bear Lodge ranges, in Wyoming, contain large areas of grass lands, the former expanding toward the south into a broad, irregular plateau, a very considerable portion of which is covered with a fine sod of native grasses. In many portions of this region the mountains are fringed with an irregular series of foothills, which pass sometimes abruptly, sometimes gradually, into table-lands or mesas, and these in turn are followed by broad valleys and open prairies or plains proper. The frequent arrangement of the land along streams into terraces or successive "benches" is of considerable importance from an agricultural point of view, since very often the table-lands differ considerably from the valleys below as to the supply of moisture and the earliness and length of the growing season. This is well illustrated by the Gallatin Valley about Bozeman, Mont., where the season is much earlier on the table-lands. Often it is a difficult matter to get water for irrigation upon these benches, and farmers must depend upon the snow and rain for the supply of moisture for their crops. Along some of the streams, as in the case of the Big Horn River in Wyoming, there are no benches or terraces, the valley being limited by high, abrupt bluffs leading to the uplands which rise gradually to the foothills and mountains.

Extending to the eastward from the principal ranges of the Continental Divide are the vast stretches of level plain, rolling prairie, and rough, eroded bad lands, constituting the great range region east of the Rocky Mountains. Over a considerable portion of this region rugged buttes are scattered here and there in addition to the previously mentioned outlying mountains, relieving the monotony of prairie and plain and affording welcome landmarks for the cowboy and traveler. Occasionally considerable portions of the plains area are cut off from the remainder by natural barriers of hills and mountain ranges, forming drainage basins of considerable extent, as in the case of the Judith basin, in Montana, and the Big Horn basin and the Laramie plains, in Wyoming.

THE SOIL.

The character of the soil in the eastern Rocky Mountain region is exceedingly varied. According to Prof. W. C. Knight, "the various geological formations which have entered into the soils of Wyoming range from Archæan to the Pliocene Tertiary," and the great variability in the composition of the different soils is readily explained from the fact that "some of them have been derived from the entire series of rocks ranging from the Archæan to the close of the Tertiary, while others are the result of the decaying of a single geological horizon." These statements are essentially true of Montana and Colorado. The soil in the valleys varies from light sandy loam to a heavy black loam or a stiff clay. Sometimes a great deal of gravel is present, and often, particularly in the higher valleys, the surface is strewn with bowlders of various sizes brought down by glaciers or mountain torrents. These bowlders are particularly abundant in the valleys of some of the streams rising in the Big Horn, Shoshone, and Medicine Bow mountains, often rendering it practically impossible to drive through with a wagon. The ranchers assert that when the land is brought under irrigation these bowlders gradually work into the soil and in a few years all the smaller ones disappear beneath the surface, making it possible to use the land for hay meadows. The soil is usually fertile and gives excellent yields of grass. In many places the clay contains quantities of "alkali" and constitutes the so-called "gumbo" and "adobe" soils. The soil of the foothills and mesas is usually quite sandy or gravelly, and is warmer, and hence earlier, than the heavier soil of the valleys. On the prairies and plains the soil varies from a sandy to a clay loam, in some places thick and well supplied with humus, in others thin and poor. Throughout the greater part of this region the subsoil is clayey, but in some localities, particularly near the mountains, where the drift and wash is great, it may be quite gravelly in nature. Over the entire region, outside of the mountains and higher foothills, the soil is characterized by the presence of a greater or less amount of alkali. In the well-drained soils of the foothills, mesas, and rolling prairies the amount of alkali present is usually small, but in the broad, flat valleys and level plains it is often large—sometimes so great as to completely change the character of the vegetation. (See fig. 3.) The water from rains and melting snows passes over and through the surface soil and leaches out the alkali, which is carried to the streams, lakes, and ponds. Naturally, much of this water is gathered into low places in the plains and valleys, where it is evaporated rapidly, leaving the alkali in the surrounding soil. In many places the alkali has been brought to the surface in considerable quantities as a result of improper irrigation. This is especially likely to occur if water is used in large quantities and then allowed to evaporate from the surface. This may be avoided in a large degree by frequent and shallow cultivation after each application of water. Often the water used in irrigating is heavily charged with alkali, which, added to that already present in the soil, ultimately renders the latter unfit for the successful growing of the ordinary farm crops. In popular parlance there are two kinds of "alkali" lands—"black alkali" and "white alkali." The former owes its peculiarities to the presence of salsoda (sodium carbonate) and the latter to the presence of Glauber salt (sodium sulphate) and Epsom salt (magnesium sulphate). The "black alkali" is much more injurious to vegetation than the "white alkali," and fortunately is much less common in this region.

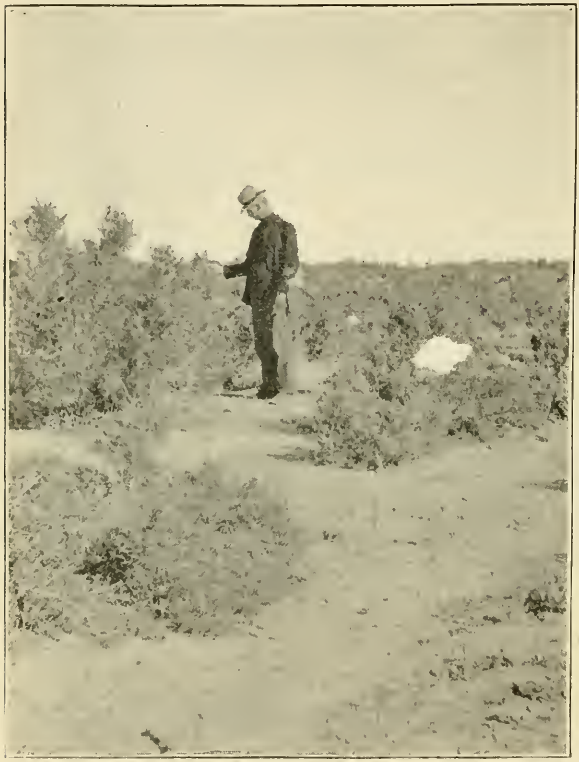

FIG. 3.—An "Alkali spot," showing characteristic greasewood vegetation.

THE WATER SUPPLY.

Over a considerable portion of the region under consideration the annual precipitation, or rainfall, is quite limited. In the great-plains area it is not probable that the average would be over 10 or 12 inches per annum—more in the favored localities and less elsewhere. On the mountains and in their immediate vicinity water is usually abundant, and were it not for the many lofty peaks, whose perennial snows supply the streams originating in them, the country would be a desert indeed, and agriculture impossible. As it is, the farmer or stockman is filled with joy when he sees the mountain tops becoming whitened with heavy snows; for they promise him a plentiful supply of water for his crops and his stock during the summer months. Countless streams fed by these snows find their way down to the plain, where they unite to form the larger water-courses—the Missouri, Yellowstone, Platte, and Arkansas rivers. Were it possible to properly husband the water flowing in these streams so that it could be distributed over the land when it is most needed, the forage problem would be a simple one and easily settled in a very large portion of this region for a long time to come.

Under the present condition much of the water runs off during the spring freshets and is lost, wh[illegible]rops and stock often suffer severely for water later in the season. This trouble is sometimes aggravated by the removal of the forest cover in the mountains by fires or by the wholesale cutting of timber. The proper maintenance of this forest cover about the source of the streams furnishing water for irrigation is a matter of vital importance to this whole region, and every possible effort should be put forth to secure it from destruction. A correspondent from Routt County, Colo., writes, "The greatest evil to the range is the destruction of the timber and underbrush at the head of the streams through fires," and many other correspondents have expressed similar views. A good illustration of the injurious effect of the destruction of the forest cover was observed the past season in the Big Horn Mountains, where thousands of acres of spruce and pine timber have been killed by fire, allowing the early and rapid running off of water from the melting snows, and a consequent shortage later in the season in the streams depending upon them for their supply.

Out on the plains, away from the mountains, not only is the precipitation less, but the streams are farther apart, and many of them, because of the excessive evaporation or porous character of the bed, become dry during the summer and autumn months, so that the water supply is insufficient for irrigation, and often it is difficult and sometimes even impossible for the rancher to obtain enough to water his stock. Animals wandering back and forth in search of water trample out and destroy many of the valuable grasses which would otherwise be able to survive the drought. During freshets resulting from melting of the snows in the spring on such a wide expanse of territory, with little if anything to retard the rush of the water into the streams and low places, immense quantities of water are entirely lost. Again, the rain often comes in such sudden and violent storms that but a small proportion of it has time to soak into the soil, the rest rushes into the water-courses, and is speedily carried away. Thus many localities suffer from lack of water, although the annual precipitation, could it be preserved, would, perhaps, be amply sufficient for present needs.

The Belle Fourche River drains a considerable territory in north-eastern Wyoming, and during the spring it becomes a raging torrent, carrying off immense quantities of water, while it is often so low during the dry season that no water runs through it in the upper part of its course. The construction of reservoirs to catch and retain the water from the rains and melting snow would undoubtedly go a long way toward the solution of the forage question in many localities on the open ranges. In many places there are natural basins which could be made into reservoirs at a very small expense compared with the great good to the farmers and stockmen which this conservation of water would accomplish.

The excessive trampling of the stock and consequent packing of the soil and the destruction of vegetation in the immediate vicinity of the springs and small streams are no doubt largely responsible for the fact that many of them are now dry for some time during the summer and autumn, though in former years they furnished water throughout the season. Very naturally the stock eats the forage nearest to the watering places first. Soon the vegetation becomes closely cropped, and as the animals visit the watering places daily, the plants are allowed no opportunity to recuperate, and as a result the ground is soon almost or quite destitute of vegetation.

PRESENT ASPECT OF THE FORAGE PROBLEM.

The aspect of the forage question has changed very materially throughout the eastern Rocky Mountain region in the past ten or fifteen years. Formerly comparatively little general agriculture was practiced, except in a few localities near the larger cities and towns. Lack of moisture or of facilities for irrigation made it difficult to secure good crops. Many of the early settlers were engaged in mining, and in the eager search for gold and silver found little time or inclination to engage in agricultural pursuits unless forced to do so by the failure of their mining ventures; others, noticing the great abundance of nutritious forage, bent their energies toward getting together as much stock as possible in order that they might take full advantage of this great natural resource. This course soon resulted in the establishment of numerous large ranches, each controlling a wide stretch of territory, and naturally discouraged the taking up of tillable lands for general agricultural purposes. Hence, farming was largely confined to small inclosed areas on the ranches and to the more protected localities near the larger settlements. Owing to the light rainfall during the summer and autumn the native grasses cured on the ground in such excellent condition that little if any hay or grain was necessary to carry the stock through the winter, and the rancher preferred to buy imported flour and canned fruits and vegetables than to bother about farming.

Upon the advent of the recent series of dry seasons it soon became evident that the ranges were too heavily stocked. Ranchmen were forced to provide forage for their stock in order to carry it through the winter. This has led to the fencing of hay meadows and the cultivation of alfalfa, timothy, and other hay and forage crops. But this made stock raising more expensive and forced many of the large concerns to go out of business. Then, too, as irrigation began to be practiced it soon became evident that many portions of the region were adapted to general farming, and settlers began to take up the land along the streams and to plant it to crops of various kinds. This interfered with the methods of ranging stock practiced on the large ranches, and the stockmen were forced to reduce their herds or seek new ranges. Very often it was found to be more profitable to divide the big ranch into small holdings and sell or rent to farmers and small ranchmen than to continue in the stock business.

In many instances the stockmen owned but little, or none, of the land over which their stock grazed, and their improvements were of little value. In other cases large tracts of land had been purchased or leased and considerable sums of money expended in building fences and making other improvements. As the country has become more and more settled, the former class has largely disappeared. The ranches of the latter class have either accommodated themselves to the changed conditions and developed into the large successfully conducted stock-growing establishments of to-day or have given way entirely to the smaller ranch and farm, where a combination of stock raising and crop growing is practiced.

This changed condition of things is very apparent in northern Wyoming, where in many places the land of the valleys has recently been brought under irrigation and affords fine crops of wheat, oats, rye, barley, early corn, timothy, clover, redtop, and alfalfa. On the Gray Bull River and elsewhere in the Big Horn Basin the change has been brought about largely within the past five or ten years. Instead of the large herds, controlled by a comparatively few wealthy men or by stock companies, the tendency is toward the smaller herds of the individual rancher. Instead of depending so largely upon the Southwest for young cattle the ranchmen are beginning to raise more young stock themselves, and they are beginning to handle better-bred animals and to bring them to a marketable condition at an earlier age.

One of the most pressing needs of this region is a hay plant that will endure the dry weather and afford profitable yields. In localities where water can be had for irrigation there is usually little difficulty in raising plenty of alfalfa, and then the need is for a supplementary hay or forage of some sort in order that the alfalfa may be fed to the best advantage. For much the greater portion of the region, however, irrigation is either impossible or impracticable, and here a drought-resistant grass or forage crop is very much needed. Nearly six hundred farmers and stockmen, representing nearly every county in the States of Colorado, Wyoming, and Montana, and many from adjoining States, in answer to the question, what is your present greatest need in the way of forage, place hay and winter forage first, almost without exception. In some localities winter pasturage is deemed more necessary than hay or coarse forage, but with the changes in the methods of handling cattle and the growing tendency toward winter feeding the use of various kinds of hay and fodder crops is yearly becoming more general. This, together with the fact that in many localities the range has been so reduced by drought and overstocking that it is hardly sufficient for summer paturage alone, making winter feeding absolutely necessary, renders the demand for hay and fodder crops imperative. Then again, the heavy losses of stock during some of the severe storms of recent years have taught the ranchmen the necessity of providing winter feed as a precautionary measure, if for no other reason.

Of scarcely less importance than winter feed, and by some ranchmen regarded of even more importance, is the need of early pasturage. There is a period of a month or more, after the breaking up of winter and before the native grasses get started, which is one of the most critical for the ranchmen of this region. Stock is more or less weakened as a result of the winter season, and palatable food is usually exceedingly scarce. The stockmen say that if some grass could be introduced that would provide pasturage earlier than the native grasses do, it would be worth many thousands of dollars to them annually.

Another matter of great importance to the ranchmen of the Northwest is the question of autumn forage. The native grasses on the open ranges dry up in the latter part of the summer. Formerly the growth was sufficiently abundant to provide plenty of well cured nutritious forage, but now the ranges are so bare in many localities at the end of the summer that stock can get practically no autumn grazing outside of the fenced areas. Near the mountains the custom is to range the stock in the higher foothills and mountain valleys during the summer, and upon the appearance of the early snows to take it down into the lower foothills, where it is kept during the autumn, or often the entire winter; but in many places drought and overstocking have so depleted these fall and winter grazing lands that they now afford comparatively little forage and are becoming covered with worthless weeds. In such localities it is necessary to begin feeding the stock long before winter begins in order to keep it in good condition. The rancher regards as his most favorable season one in which there is a heavy rainfall during the spring and early summer months, a dry autumn and an open winter, with little snowfall or with high winds to blow the snow into the ravines and gullies. This gives a heavy growth of grass, which cures on the ground, where it can be grazed by the stock during the late fall and winter.

A considerable portion of this region has an altitude too great for the successful growing of alfalfa and other commonly cultivated forage crops, although it includes a great deal of rich land well supplied with natural moisture or capable of being irrigated readily. Thus in Montana the altitudinal limit for the successful growing of alfalfa ranges from about 4,500 to 5,000 feet, and more than one-half of the total area of the State is above this limit; in Wyoming its altitudinal limit seems to be not far from 5,000 feet, and over three fourths of the State is above this altitude; in Colorado it can be successfully grown up to about 6,500 feet in the northern and 7,500 feet in the southern part of the State, and nearly one-half of the State is above this limit. Timothy can usually be successfully grown at an altitude of from 500 to 1.000 feet above that of the limit for alfalfa, and hence replaces it to a greater or less extent, but there is a very decided demand by the farmers and stockmen for a forage crop adapted to these higher altitudes. Mr. T. P. McDonald, of Carbon County, Mont., expresses the sentiment of many when he writes, "We need a good forage plant that will grow and mature above the 5,000-foot level."

In addition to the above-mentioned needs, all of which are of quite general importance, there are many of more or less local significance demanding the attention of the investigator and the farmer. Although alfalfa and other coarse crops can be raised successfully in most localities and are good for hay, they are not satisfactory for general pasturage, and there is a demand for a good pasture grass to be grown under irrigation. In other localities the land is too strongly impregnated with alkali, either from natural causes or through injudicious irrigation, for the successful cultivation of the ordinary forage crops, and plants are desired that will flourish on such soil. In still other localities, particularly near the larger cities and towns, crops suitable for soiling are needed.

In some instances the present lack of forage is due quite as much to the slowness of the farmers and stockmen to adapt themselves to the existing conditions as it is to the want of suitable crops for cultivation. It is hard to get out of the old slip-shod ways, even though it is known that a little well-directed effort will make a given amount of land yield several times as much forage as it did formerly. Careful attention to the development of native meadows and pastures and a more general cultivation of miscellaneous forage crops that can be grown with at least a fair degree of success in nearly all localities will do much toward solving the forage problem.

The effect of such effort is well illustrated by the excellent native meadows that have been produced by intelligent irrigation, examples of which may be seen along the valleys of the Platte, Bear, Gallatin, and Belle Fourche rivers, in the Big Horn Basin, as well as along many other streams of the region. On the other hand, the injurious effect of careless treatment is very apparent on many ranches where, because there is a great abundance of water, the meadows are kept so wet that the better grasses are driven out and their places taken by sedges and rushes, producing an inferior quality of hay.

The following description of the conditions prevailing on the range between the Missouri River, in South Dakota, and the Upper Belle Fourche River, in Wyoming, may be taken as typical of those obtaining over the Northwest generally and illustrative of the marked effect that an isolated mountainous region like the Black Hills may have upon forage production and agriculture in general. The notes were taken during a wagon trip from the Cheyenne Indian Agency, on the Missouri River, up the Moreau River and across to the Belle Fourche River, in northeastern Wyoming, and back through the southern Black Hills to Pierre, S. Dak.

FORAGE CONDITIONS ON THE RANGE OF WESTERN SOUTH DAKOTA AND NORTHEASTERN WYOMING.*

CHEYENNE AGENCY TO BELLE FOURCHE RIVER.

This region varies greatly in the character of its surface. The land near the streams, especially the Moreau and the Missouri rivers, is exceptionally rough. There are no great elevations or depressions, but the smaller ones are a host. Back 3 or 4 miles from the river there are table lands of considerable extent which are comparatively level, even in the lower course. Farther west the country is not so rough, the region from the mouth of Thunder Creek to the Belle Fourche being an undulating prairie.

The soil over a large part of the eastern portion of the region resembles that east of the Missouri River very much. The humus decreases gradually to the westward and one encounters more gumbo. The whole region is covered with grass except occasional small spots of gumbo and the steeper bluffs along the Moreau and Missouri rivers. The eastern portion of the region differs from the western also in having fewer sandy knolls.

All the streams tributary to the Moreau and Cheyenne are wooded to some extent. There are two or three conditions which are suggestive in regard to the growth of timber. The soil is heavy and does not allow the water to percolate through it very easily, but when once started washes badly. This leads to washouts and holes in the stream beds which hold water until late in the summer. The trees getting started around these water-holes are supplied with sufficient moisture during the growing season. The stockmen and Indians have exercised much vigilance of late in keeping out fires. Near Bixby it was stated that it has been ten years since fire has passed over that region. When fire does get started, it is not so destructive to trees and shrubbery as it would be if there was more grass on the ground. Almost invariably we found the feed very short near the water-holes. During the summer the range cattle feed near the water, working back on to the open range as feed conditions demand. Consequently, by the time vegetation is dry enough to burn, the grass in the vicinity of the water-holes is very short and fire does not do so much damage.

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*Abstract from the report of Mr. David Griffiths, who served as field agent for the division in South Dakota and Wyoming under a commission extending from the middle of July to the middle of September, 1897.

The timber along the Moreau is made up of cottonwood, willows, buffalo berry, box elder, green ash, white elm, plums, and cherries, with buck-bush, poison oak, and various species of rose as undershrubs. On the bluffs on either side are found *Rhus trilobata* and an occasional red cedar. Sage-brush (*Artemisia longifolia*) is common over limited areas in the western portion of the region, while species of cactus are common everywhere.

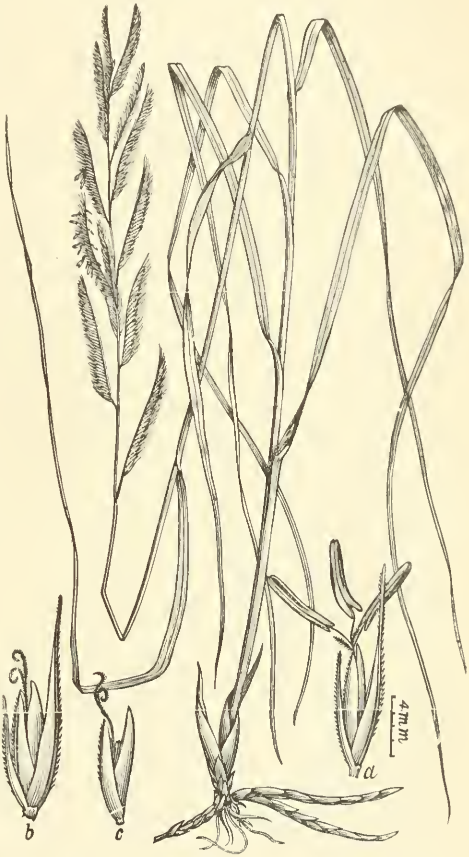

FIG. 4.—Fresh-water cord-grass (*Spartina cynosuroides*): *a*, spikelet, showing three stamens; *b*, spikelet, showing the projecting stigmas of the pistil; *c*, the same, with the outer glumes removed.

The feed on the Indian reservation is much superior to that farther west, the main reason for this being that it is not pastured so closely. The Indians have only a few cattle, and it appeared that they were taking considerable pains to keep the feed along the Moreau River for winter use. However this may be, we saw but few cattle on the river bottom while on the reservation. Neither were any Indians seen excepting at three points on the river. Their log houses and stables were in evidence all along, but no Indians or cattle to speak of. They were congregated at White Horse camp and the agency. Near each one of these houses was a small piece of ground, from 2 to 3 acres, fenced and under cultivation. Their crops consist of corn, potatoes, pumpkins, and melons. These were usually well tended and a good crop. There were a few pieces of wheat which were an average crop. The Indians evidently do not cultivate the same piece of ground for many years in succession. It was not an uncommon thing to find patches of ground, which had once been under cultivation, all grown up to weeds, and the fence removed from it, possibly to get fresh soil, but probably more often to get rid of the weeds. It was learned that the Indians make almost no preparation for winter feeding, except to save, as much as possible, the feed around their winter quarters. As they have but a small bunch of cattle, they are able to keep close watch of them. Quite a number of cattle were seen which were being driven down to the agency to be sold for beef. They were invariably in good condition.

After leaving the Missouri bottoms no big sand-grass (*Calamovilfa longifolia*) was noticed until the party arrived at the Moreau near White Horse camp. Big cord-grass (*Spartina cynosuroides*) (fig. 4) is the principal grass along the ravines and gullies, and big sand-grass is very common on the knolls farther west. The distribution of big sand-grass, of course, throws much light on the character of the soil. Both of these grasses were pastured closely in the western portion of the region where the feed was short. Usually these grasses are not cut for hay, but this season it is said that they will form the bulk of it, owing to the scarcity of wheat-grass.

Prairie June-grass (*Koeleria cristata*) is a much more important grass on the high prairie in the eastern portion of this region than anywhere else we visited. The small table lands back 3 or 4 miles from the river invariably contain fine growths of this grass, at times almost to the exclusion of the other grasses. There was a large area near Virgin Buttes that stood 10 inches high and so thick that the heads which were then ripe gave a brown appearance to the whole area. It is very common on all the high ground.

Porcupine-grass (*Stipa spartea*) and needle-grass (*Stipa comata*) are found to some extent all along the Moreau bottoms, the latter becoming a very important pasture grass to the westward. Feather bunch-grass (*S. viridula*) is more important on the highland regions eastward. Here it is a very valuable pasture grass and is often found with western wheat-grass (*Agropyron spicatum*) and blue grama (*Bouteloua oligostachya*) in sufficient quantity to make considerable hay.

The more important grasses and forage plants of the region are as follows: Blue grama (*Bouteloua oligostachya*), western wheat-grass (*Agropyron spicatum*), big blue-stem (*Andropogon provincialis*), prairie June-grass (*Koeleria cristata*), big cord-grass (*Spartina cynosuroides*), needle-grass (*Stipa comata*), feather bunch-grass (*S. viridula*), big sand-grass (*Calamovilfa longifolia*), buffalo-grass (*Bulbilis dactyloides*), Dakota vetch (*Lotus americanus*), wild rye (*Elymus canadensis*), and *Carex filifolia.* The last is of special value early in the season.

Dakota vetch (*Lotus americanus*) is very abundant along the river bottoms. There are often large patches of it which are almost pure. If this proves valuable under cultivation it will be easily propagated, for it produces an abundance of seed. It has, however, the disadvantage of ripening its seed unevenly. Usually the older pods have burst open before the later ones have ripened.

BUTTE POST-OFFICE TO DEVILS TOWER.

The change that takes place as one proceeds along the Owl Butte road from Dead Horse Creek toward the foothills of the Black Hills is something wonderful. One passes from a region where the ranches are 5 to 40 miles apart, where there is practically no cultivation, and where there is nothing to break the monotony of the scene but bunches of cattle feeding in the "draws" and an occasional patch of scrubby box elder and ash on the creek bottoms, to a thickly settled region, where there are good buildings, excellent crops of grain and hay, and where everything in the shape of vegetation makes a thrifty growth. The greater part of the land along the Belle Fourche from Butte to the Tower is fenced, either for growing cultivated crops or for winter feed. For about half the distance from Butte to Belle Fourche the route was through a narrow lane left for a road and in which there was no feed whatever—everything being pastured closely. The farmers fence their crops, pastures, and hay land, and turn their cattle out into the roads which lead into the Black Hills on one side and into the open range on the other. The party, at times, experienced some trouble in finding feed for their horses.

Nearly everything depends on irrigation here, the water being carried from tributaries of the Belle Fourche by a system of ditches and sluices onto the land. Nowhere is water taken from the Belle Fourche itself, the reason being that the river has not sufficient fall to enable farmers to get the water onto the land without too great an expense. It was learned also that the volume of water in the river fluctuates greatly, a rise of many feet occurring in a few hours at times when heavy rains fall in portions of its drainage basin. Damming has been tried in several localities without success. As the tributaries from the hills are quite numerous, the farmers are usually able, by judicious management, to get a sufficient volume of water for their crops from them. Usually the water is exhausted before the middle of July, but by an intelligent use of their supply during May and June they are able to raise fine crops. In many instances the farmers get along by building a dam across a gully and holding the water derived from melting snows and spring rains until it is needed later in the season. In the immediate vicinity of Belle Fourche opportunity was afforded to study the effect of an abundant supply of water the entire season. It is here obtained from one of the tributaries of the Red Water.

Here was found a most luxuriant growth of both native and cultivated vegetation. As fine fields of wheat were found here as in the great small-grain belt in the eastern part of the State, while the hay crop was something wonderful. The unirrigated lands, however, presented an appearance not unlike the drier portions of the open range farther east.

The principal hay crop is alfalfa, of which, they obtain about 4 tons per acre from three cuttings, which is the usual method of handling. The farmers were experimenting with a fourth cutting this year, and were considerably encouraged over the prospect at the time the region was visited. This crop is prized very highly because of the fact that they are able to get such a yield per acre. Many other hay crops are grown very successfully, but none yields such a quantity of feed as this one.

Redtop makes the finest growth here of any place visited on the trip. On the Seth Bullock ranch there is a large meadow which was sown to redtop and timothy eight or ten years ago. The timothy is now nearly all run out, while the redtop this year is a fine stand about two feet high.

Besides the above may be mentioned timothy, white sweet clover (*Melilotus alba*), millet, and June clover, all of which make good growths. White sweet clover (*Melilotus alba*) is so persistent in its habits that it assumes much of the characteristics of a weed along the ditches and among other perennial forage crops. It makes an immense growth wherever it gets started on irrigated land. At Belle Fourche was seen near a spring about an acre that stood about 9 feet high.

Native grasses are also irrigated with good success. When, however, a piece of ground is irrigated year after year, that invaluable species, *Agropyron spicatum*, runs the other grasses out. Several instances of this were seen and attention was called to it, not only in the vicinity of Belle Fourche, but farther west, in Wyoming, as well. The most striking example was near Snoma, S. Dak., where there was a meadow of 30 or 40 acres of this grass, with a crop of about 2 tons to the acre. About one-fourth of it was headed out. It was raining at the time of the visit and the grass, therefore, looked fresh and thrifty. Such a large field of this glaucous-leafed grass made a very pretty sight. It was ascertained that this meadow had been irrigated and cut for five consecutive years with a good crop of hay upon it each year. Such a condition is really extraordinary, for ranchmen on the range and even the farmers in the eastern part of the State are seldom able to cut crops of this on the same ground for more than two years in succession. Even when pastured closely year after year the quantity of feed becomes very small. But this is simply one more evidence of what a proper amount of water will accomplish when applied to this soil.

Barnyard-grass (*Panicum crus-galli*) makes a fine growth along the ditches and roadsides where the sod has been partially subdued. It has two distinct forms of growth. Along the ditches and among other grasses it assumes an upright form, while along roads and in barnyards, where the ground is packed down to some extent, it is almost prostrate and often strikes root at the joints. It appears to thrive as well under this form of irrigation as it does under artesian irrigation in the eastern part of the State.

Squirrel-tail grass (*Hordeum jubatum*) is a bad weed wherever the perennial grasses are irrigated on low, alkaline ground.

Besides the usual forage crops there is a great deal of rye, wheat, and oats cut for hay. Winter rye is usually sown. These crops are resorted to only in the drier portions of the region or where no water is available for irrigating purposes. Although small grain is raised here successfully with irrigation, the main crop is hay. There is considerable feeding done during the winter. The big cattle companies make provision with the settlers here, and also with the ranchmen farther out on the range, for the wintering of calves and weak cows which are picked up during the last beef "round-up" in the fall.

The distribution of precipitation is very peculiar. The rainfall is much more abundant in the vicinity of the Black Hills than on the open range on either side. While irrigation is resorted to with profit wherever practicable, the region is not dependent on it entirely. Occasionally good crops of grain are raised without irrigation, but it is rather uncertain. When wheat and oats are sown for the grain and the crop proves to be a failure, it can usually be told in time so that it can be cut early enough to make good hay, which is always in demand. In the vicinity of Sundance, Wyo., and elsewhere along the base of the Bear Lodge Mountains, very fair crops are usually raised with no artificial watering. This year the prospects near Sundance were very good, but they had the misfortune of being "hailed" out.

The Bear Lodge Mountains are in general covered with pine (*Pinus scopulorum*), with an occasional grove of oak, poplar, and birch. The pine is especially heavy on the outer slopes of the mountains and in the "draws" and gulches farther up. Along the divides and edges of "draws" there is very fine pasturage. The range cattle do not get in here to any extent, partly from choice but principally on account of the fact that ranchers have fenced most of the land along the base of the mountains separating the open range from the mountain pasture lands. Common along the Bear Lodge Mountains is King's fescue (*Festuca kingii*), which makes a fine growth below the lower timber line and is very common at higher elevations. It is highly prized by the ranchmen along the base of the mountains on account of its early spring growth. It furnishes pasturage at a much earlier date than any other native grass. Occasionally it makes some hay, but it is looked upon as a pasture rather than a hay grass.

DEVILS TOWER TO NEW CASTLE.

As one proceeds up the Belle Fourche from the Tower he can not help but notice the gradual decrease of the pine timber. It becomes more and more scrubby until it practically disappears at the mouth of Wind Creek. On the bluffs on either side of the stream is a growth of pine, with some oak, and on the bottoms there is a good growth of cottonwood, with more or less of the buffalo berry, green ash, box elder, and an occasional plum and cherry thicket. There is always a very vigorous growth of roses, buck-bush, and sage-brush. There are large areas on the bottoms covered with long-leafed sage (*Artemisia longifolia*), almost to the exclusion of other vegetation.

Some difficulty was experienced in finding feed for the horses in the upper Belle Fourche region, not that the country is not productive, but there are too many cattle. It would be difficult to tell what grasses grow on the river bottom were it not for the winter pastures which are fenced in. During the two nights spent here the party managed to camp in these winter pastures where there were good growths of blue grama (*Bouteloua oligostachya*), needle-grass (*Stipa comata*), feather bunch-grass (*S. viridula*), western wheat-grass (*Agropyron spicatum*), prairie June-grass (*Koeleria cristata*), big sand-grass (*Calamovilfa longifolia*), big cord-grass (*Spartina cynosuroides*), slender cord-grass (*S. gracilis*), wild rye (*Elymus canadensis*), sand rush-grass (*Sporobolus cryptandrus*), and Montana sand grass (*Calamagrostis montanensis*). The main hay grass is western wheat-grass, which is cut in fenced areas along the river bottoms and farther back on the range, along creek bottoms. Water for irrigating purposes is rather scarce, but wherever found and used good crops of alfalfa are raised. The rainfall is much less than it is in the vicinity of the Bear Lodge Mountains. As near as we were able to learn the rainfall is seldom sufficient to mature a crop of small grain after one gets 10 miles west of the Bear Lodge Mountains.

It appears to be the common experience that native sod when irrigated grows up almost exclusively to *Agropyron spicatum*, which is known by the name of wheat-grass. Several instances of this were seen—one at Mr. Baugh's, another at Mr. McKean's, farther up the river.

A great deal of the country about Moorcroft is covered with species of sage-brush, salt-sage, greasewood, and cactus. This is in the edge of the sage-brush plains of Wyoming. To the east are the hills, covered with a good growth of pine. This condition continues nearly to Merino, where the railroad works back toward the western timber line of the foothills. The soil is largely of a clayey nature, much of it of the sort popularly called "gumbo," and washes very badly. The rain does not soak into the ground much, but runs off into the streams, often swelling them to enormous extent. Among the sage-brush and cacti are good growths of grasses, generally those which do not form a sod under ordinary conditions. Among the most important may be mentioned needle-grass (*Stipa comata*) and western wheat-grass (*Agropyron spicatum*). On the divides are found big sand-grass (*Calamovilfa longifolia*) and blue grama (*Bouteloua oligostachya*), while big cord grass (*Spartina cynosuroides*) and salt-grass (*Distichlis spicata*) are the most common on the low ground. Needle-grass (*Stipa comata*) is a very important grass in this region. Northwest of New Castle, near the junction of the Burlington and Missouri River Railroad and Skull Creek, it is especially common. In this vicinity and extending southward into the oil regions are large areas among the sage-brush where no other grasses grow.

As one approaches Inyan Kara Mountain the country assumes much the appearance of that around Sundance, as would be expected. There are more streams, and consequently more water available for irrigation. The rainfall is also more abundant, and the soil has more sand and humus in its make-up. The mountain and all the elevations in the neighborhood are covered with pine, while groves of poplar, birch, and oak are common. The creeks have a growth of cottonwood, box elder, and green ash. Springs of pure soft water are common near the base of the mountain.

Near Inyan Kara we found a ranchman drilling with the expectation of getting a flow of water. He started in last year, when he struck a stratum from which water raised within a few feet of the surface. He renewed his efforts this year, hoping to get a sufficient flow to irrigate from. The open range is closely pastured here also. Here again it was learned that until about four years ago hay could be cut anywhere on the upland, but for the past few years the cattle have become so numerous that they keep the grass eaten off so closely that the effect is much the same as successive cutting year after year. Occasionally a ranchman attributes the short crop of the past few years to drought, but the majority of them agree that it is due to overstocking.

We found more and better farming along Skull Creek than along the Upper Belle Fourche. This is probably due largely to the better facilities for irrigation. There are ranches at short distances along the creek, and considerable hay was being put up. Alfalfa is their main crop whenever they can get water onto the land. Timothy is raised to some extent, and rye and oats are common hay crops. No running water was found until the party got down near the Burlington and Missouri River Railroad. There is as good an illustration of the effect of water on the growth of vegetation here as one could wish to see. On the one hand there is a perfect wilderness of sage-brush (*Artemisia longifolia* and *A. tridentata*) as far as the eye can reach, with the usual light growth of grass, forming no sod to speak of; on the other, native grasses, alfalfa, oats, and garden truck make a fine growth with artificial watering.

THE SOUTHERN BLACK HILLS REGION.

The arable land in the region between New Castle, Wyo., and Rapid City, S. Dak., is confined to the valleys and creek bottoms which lie between the different ridges in the Black Hills upheaval. The crops raised are about the same as at Belle Fourche and along the eastern foothills. It appears to be the practice in localities here as at Belle Fourche to seed for a crop of grain, and if the yield does not promise well it is cut for hay before it becomes thoroughly ripened. Some very fine crops of alfalfa, wheat, and oats were seen in Spring Creek Valley. Redtop and timothy are common on the larger areas of low ground. Redtop is especially abundant, and there was a fine crop of hay in Rapid Creek Valley to the southwest of Rapid City.

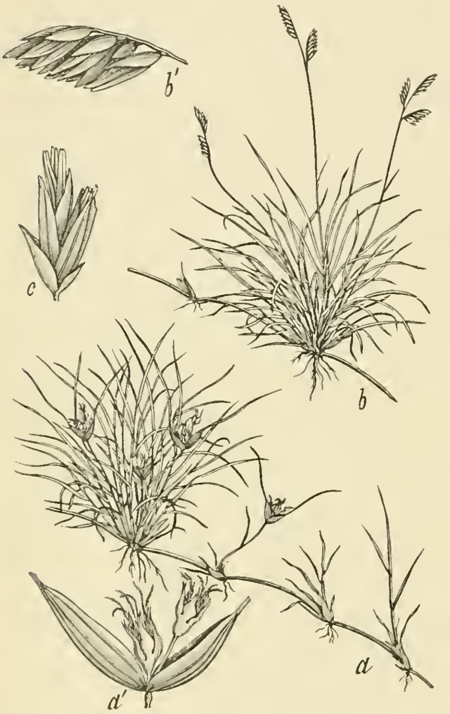

FIG. 5.—Buffalo-grass (*Bulbilis dactyloides*): *a*, female plant; *b*, male plant; *a′*, two clusters of female spikelets; *b′*, a branch of several staminate spikelets; *c*, a male or staminate spikelet of two flowers.

The climatic conditions are in marked contrast with those at a lower elevation. Harvesting was in progress in the vicinity of Belle Fourche the 1st of August, but 20 or 25 days later, when the party crossed the Black Hills on their return trip, a great deal of wheat and oats were still green. Only about one-half of the crop through the hills had been cut at this late date.

A beautiful arrangement of native grasses is found along the foothills near Rapid City. There are a great many cattle pastured here, and the grasses are consequently kept eaten down quite closely. There are three species, which form a perfect sod in places. The country is rolling—sometimes hilly. In the depressions are patches of ground several acres in extent which are as smooth as though they had been laid out by artificial means. On these areas are full sods of blue grama (*Bouteloua oligostachya*), black grama (*B. hirsuta*), and buffalo-grass (*Bulbilis dactyloides*) (see fig. 5), arranged in natural lawns, as it were, according to nature's own fantastic designs. It made a very pretty sight. No artificial lawn could be more desirable. The color of the grasses, so similar and yet so delicately different that each species growing in separate patches could be recognized at a considerable distance, the splendid sod, and the pleasing general effect suggested the possible use that might be made of these grasses for lawns, borders, and designs about dwellings, public buildings, and cemeteries.

RAPID CITY TO PIERRE.

Nowhere on the trip was better feed found than along the trail from Rapid City to Pierre. No pasturing had been done here except at certain points, as Pœno Hills and Grindstone Buttes. This is due mainly to the fact that our route lay along the divide, where water is scarce. It was the intention of the party to take the Bad River road, and they would have done so had they not been informed that everything was pastured closely all the way. Blue grama (*Bouteloua oligostachya*) makes a fine growth here and was nice and green the 1st of September. Considerable hay was being put up in the eastern portion of the region. It consisted principally of Western wheat-grass (*Agropyron spicatum*) and blue grama (*Bouteloua oligostachya*), together with some feather bunch-grass (*Stipa viridula*) and needle-grass (*S. comata*). In the "draws" there is more of the *Agropyron* and less of the *Bouteloua*. In the larger draws there is a good growth of big cord-grass (*Spartina cynosuroides*) and on the knolls a light growth of big sand-grass (*Calamovilfa longifolia*).

At Pierre the cattlemen were much exercised over the fact that the grass on the range was so backward in ripening. They were fearful lest it should remain green until frost struck it, thereby leaving their winter feed in poor condition. They were therefore well pleased with the hot, dry weather which prevailed during the first ten days in September.

CULTIVATED GRASSES AND FORAGE PLANTS.

The failure of the ranges to supply sufficient forage for all seasons of the year has led to an increased effort on the part of the stockmen and farmers to cultivate the various standard grass and forage crops. In many instances experiments have been made with the different novelties introduced and sold by seedsmen or distributed gratuitously by the United States Department of Agriculture. As was to be expected, the old and so-called "tame" grasses have refused to accommodate themselves to the extreme conditions of soil and climate prevailing in some parts of the region, and while a few of the newly introduced plants have proved valuable, many others have shown themselves to be practically worthless. The "tame" grasses most commonly found in meadows and pastures are timothy, redtop, Kentucky blue grass, smooth or Hungarian brome-grass, meadow fescue, and orchard grass. The millets and the various small grains are quite generally grown for summer forage and for hay, and corn and the sorghums, both saccharine and non-saccharine varieties, are occasionally grown for fodder. Nearly all the common clovers are successfully grown in some part of the region, alfalfa and red clover being in most general cultivation. Very few of the large ranches are without fields of timothy, redtop, clover, or alfalfa; often all are grown on the same ranch. Sometimes these fields cover hundreds of acres and yield thousands of tons of hay. Almost without exception they are irrigated, at least for a portion of the season. In many localities the proprietors of the large ranches prefer not to bother with the extensive cultivation of forage crops that would be necessary to properly feed their herds during the winter, depending upon the small ranchmen and farmers in the valleys for their winter forage supply. The hay is sold to the ranchmen, or more often the cattle are brought to the farmer and he winters them at so much per head. This winter feeding of range stock is becoming quite an industry and could, no doubt, be more generally practiced with advantage to both the large and the small ranch owner. Up to the present time winter feeding is largely, in fact almost entirely, confined to cows, calves, and bulls: the most of the stock being expected to "rustle" its living on the range except during very stormy weather, when a little hay may be fed.

TIMOTHY.

Phleum pratense.

This is more widely cultivated than any other "tame" grass in the eastern Rocky Mountain region. The cheapness of the seed, the ease with which a meadow can be seeded down, and the excellent quality of the hay make this grass a great favorite. In most localities irrigation is necessary to grow it successfully, but with plenty of water enormous yields are often obtained, particularly in the rich valleys in the northern part of the region. Reports of the successful cultivation of this grass have been received from every county in both Montana and Wyoming, and from nearly every county in Colorado, but always under irrigation except in some of the moister valleys in or near the mountains. Sage-brush lands when cleared, irrigated, and seeded to timothy make fine meadows, but the greasewood lands are too strongly impregnated with alkali. Timothy can be grown successfully at a higher altitude than most of the other commonly grown grasses, and is becoming quite generally established in waste places and along trails throughout the entire region. Several of the field agents of the division have reported finding it well established in many places in the mountains. Professor Pammel found it flourishing at an elevation of 10,500 feet in northern Colorado, and the writer found it at a similar elevation in the central part of the State. In the Bear Lodge Mountains and in the Black Hills it is very abundant at 5,000 and 6,000 feet, making a very fine growth, and is spreading very rapidly in moist, open situations along the trails. In the Big Horn Mountains of Wyoming and in the Spanish Basin in Montana it was found to be abundant, growing with alpine timothy (*Phleum alpinum* L.) at from

7,000 to 8,000 feet or more. This ability of timothy to establish itself and thrive at comparatively high altitudes makes it of special value for a large portion of this region. Speaking in this connection Mr. W. S. Coburn, of Delta County, Colo., says "timothy grows to perfection up to an elevation of 9,000 feet," and Mr. T. P. McDonald, of Carbon County, Mont., says "alfalfa and clover do well below the 4,500-foot level, but above that altitude timothy is the most successful."

REDTOP.

Agrostis alba.

This grass stands very close to timothy in its importance as a meadow grass for this region. Its cultivation is less general than that of timothy, however, being more strictly confined to the lower mountain valleys and better irrigated localities, and it is much more generally grown in Montana than in either Wyoming or Colorado. Like timothy, it is becoming well established in the native meadows and waste places. It thrives best on quite moist bottom lands, and is especially valuable on meadow lands liable to overflow. It is a common practice to sow this grass in irrigated native meadows to supplement the native species. It occupies the low marshy places and resists the encroachments of sedges and rushes better than timothy or the common native grasses. Though usually grown in connection with other grasses or with clovers, it makes a fine meadow when grown alone under proper irrigation. One of the finest redtop meadows ever seen by the writer was on a large horse ranch on the Gray Bull River, Wyoming. About 80 acres of the grass were standing at the time of the visit (August, 1897), and some had already been harvested. The land was the common sage-brush land of the valley, and had been given but little cultivation before being seeded down, but was well irrigated. The field was "as even as a floor," and as the mower passed along, it was noticed that the grass came well up along the sides of the horses. Almost all the cultivated land on this ranch was devoted to this crop, which is fed to fine-bred horses.

KENTUCKY BLUE GRASS.

Poa pratensis.

The principal use of Kentucky blue grass in this region is for lawns. With irrigation fine lawns can be made almost anywhere, if the land is not too strongly impregnated with alkali. The great difficulty often experienced in getting a good stand of this grass is one of the chief drawbacks to its culture here. The seed as sold in the markets is too often so poor that the farmer fails to get a good stand for his first sowing and gives up in disgust. Then, again, it takes some time for the grass to form a good sod, and the average Western farmer is too impatient for immediate results to wait for it. Nevertheless this grass is becoming quite abundant in many of the older settled localities and is gradually working its way into the meadows and pastures. Together with Canadian blue grass (*Poa compressa*), low spear-grass (*Poa annua*), and redtop, it follows along the irrigating ditches, forming bright green borders, and affording many juicy mouthfuls for the cattle and other stock. Like most of the other cultivated grasses, it thrives best in the rich valleys of the lower mountains and foothills, where it is protected from drought and the excessive heat of midsummer. It is indigenous in many parts of the Rocky Mountain region.

SMOOTH OR HUNGARIAN BROME-GRASS.

Bromus inermis.

Of all recent introductions smooth brome (see fig. 6) is the most promising hay and pasture grass for the dry portions of the Northwest. Not only does it possess excellent drought-resistant qualities, but it starts much earlier in the season than the common grasses and continues growing well into the autumn, two things very much to be desired in a grass for cultivation in this region at the present time.

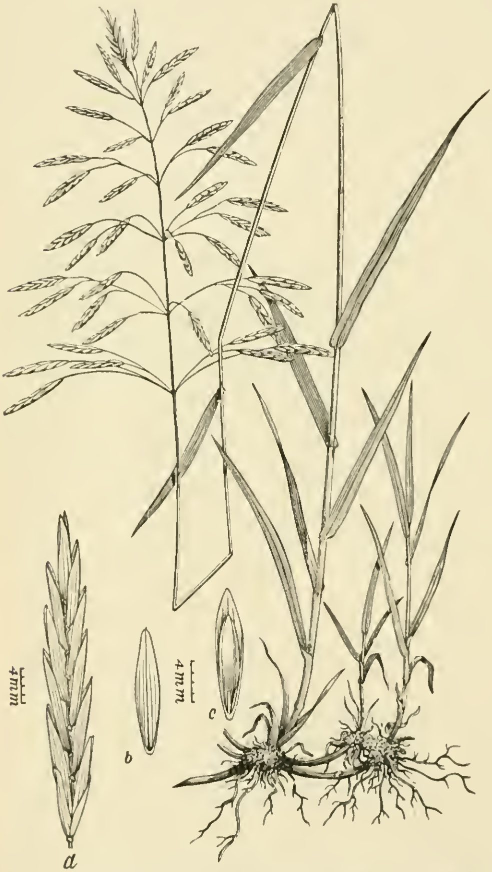

Fig. 6.—Smooth or Hungarian brome-grass (*Bromus inermis*): *a*, spikelet; *b*, flowering glume seen from the back; *c*, floret seen from the anterior side, showing palea.

In Colorado the grass has been tried in a number of localities with good success. In speaking of grasses for dry situations on the ranges, Mr. R. E. Beatty, of Arapahoe County, says, "*Bromus inermis* comes the nearest to a suitable grass that we have tried so far;" Mr. Thomas R. Pace, of Garnett, "recommends smooth brome-grass," and Mr. George C. Baker, of Mosca, says, "*Bromus inermis* is our best tame grass." It is regarded as the most promising of the introduced grasses tried at the Colorado experiment station. The grass seems to have been given less attention in Wyoming than in either Colorado or Montana. Mr. Griffiths, in his report for the past season, speaks of seeing a plot of it on the ranch of Mr. John Baugh, of Carlisle, Wyo. He says, "Mr. Baugh has been experimenting two years, both with and without irrigation. He seems to think that the smooth brome-grass does not thrive so well under irrigation. The effect of irrigation was really quite peculiar. The irrigated portion of the plot was fresh and green (middle of August) while the unirrigated portion, though it had made a much better growth, was completely dried up. I am not certain but that a thorough wetting at less frequent intervals would have produced better results. He irrigates by means of a tank and windmill. The water is conducted to the garden by a pipe and the crop is sprayed. All his garden truck looked well. Cabbage and tomatoes were especially fine." In Colorado smooth brome has done well under irrigation, particularly when pastured.

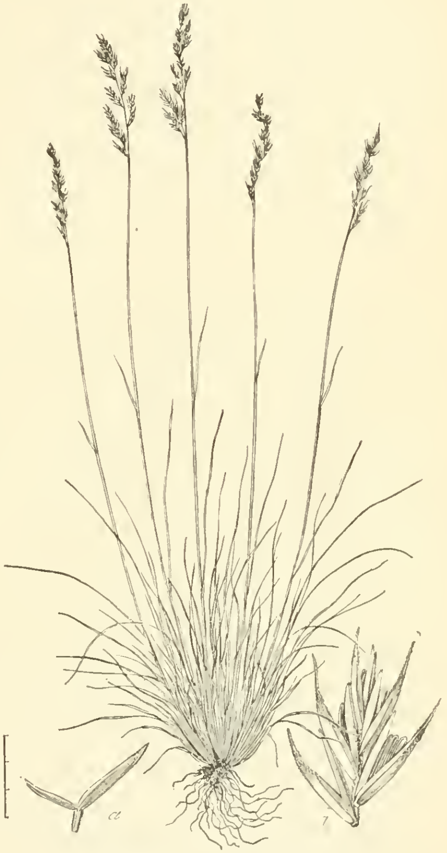

FIG. 7.—Sheep fescue (*Festuca ovina*).

In Montana smooth brome has received considerable attention, and reports regarding it are very satisfactory indeed. Hon. Paris Gibson, of Great Falls, says, "In the experiments I have made with new forage plants I find *Bromus inermis* the most hardy. It appears in the spring much earlier than our native grasses." Similar reports were received from Messrs. M. W. Jones and E. Vine, of Miles City, and from Director Emery of the State Experiment Station. Judging from these reports and from the excellent results already obtained in growing this grass in Canada, as well as in the Dakotas and other Northwestern States, it seems probable that smooth brome will prove of great value for cultivation on the dry lands of the Northwest. It should be given a thorough trial, especially as a grass for reseeding worn meadows and pastures.

THE FESCUES.

About the only fescue that seems to have been tried to any extent is meadow fescue (*Festuca elatior pratensis*), and this is only occasionally seen in cultivation—usually in mixture with other grasses or with clovers. On rich loamy soils, with abundant irrigation, it seems to do quite well. Favorable reports have been received from several points in central Colorado and central and southern Montana. Mr. Griffiths found it doing well in northeastern Wyoming. It is frequently met with along irrigating ditches and in public parks in the cities and towns, often occurring in waste places as an escape and already well established in favorable situations. It does not seem to thrive in soils containing much alkali. At the Utah Station this grass has been grown with fine success as an element in permanent pastures and meadows, and it is altogether likely that it can be so used in many portions of the Rocky Mountain region. Many native forms of both sheep fescue (*Festuca ovina*) (fig. 7) and red fescue (*Festuca rubra*) occur in this region, and although the cultivated varieties have been given little, if any, attention, it is not unlikely that they could be used to advantage in reseeding the ranges, particularly in the foothills and lower mountains.

ORCHARD GRASS.

Dactylis glomerata.

Like meadow fescue, this grass has received but little attention from farmers and ranchmen in this region. It has been tried at the experiment stations, sometimes with success and sometimes without. It requires fairly rich soil and a reasonable amount of moisture, and hence thrives best on irrigated lands of the valleys and benches. It has succeeded quite well at the Utah station, and good reports of it have been received from central and southern Montana and from many parts of Colorado. It was seen on several ranches near Evanston, Wyo., the past season and was making a fine growth. Mr. W. C. Burke, of Las Animas, Colo., in an answer to the question as to what grasses and forage plants do best in his locality, includes this grass, with the statement that "when irrigated it produces about 2 tons of hay per acre." It is deserving of more general cultivation as an element in mixtures for permanent meadows and pastures and for seeding down sparsely wooded areas.

ALFALFA.

By far the most important forage plant cultivated in this region at the present time is alfalfa. Scarcely a farm or ranch under irrigation can be found in the entire region without its alfalfa field, and on many of the larger ranches hundreds of acres are devoted almost exclusively to this crop. It flourishes on the better drained valley lands and irrigated bench lands in all parts of the region where the altitude is not too great, and alfalfa hay constitutes the principal winter feed for many thousand head of horses, sheep, and cattle. Of recent years it is being extensively used in fattening sheep and cattle for market. There is great need of a good supplementary forage to be fed along with the alfalfa. It is so rich in muscle-making food elements that, as ordinarily fed, its full value is not obtained, and ranchmen are beginning to realize the necessity of mixing it with corn fodder, sorghum, prairie hay, or other forage containing an excess of fat-forming elements in order to feed in the most economical manner.

Three or more cuttings are obtained each season unless, as is often the case, it is more desirable to pasture off the later growth. This is done when summer pasturage is scarce or when there is no market for the hay and the ranchman gets enough for his own use from the first one or two cuttings. During the past season it was learned from several ranchmen in the Big Horn Basin that they very seldom made more than two cuttings, for the reason that they needed no more for wintering their own stock and the price of the hay was so low that it paid them better to pasture their fields for a portion of the season. This was in a region where the summer pasturage was short because of drought and previous overstocking, though at the present time the number of stock kept on the range is undoubtedly much below what the land ought to support under a proper system of grazing and supplementary feeding.

One of the things which makes alfalfa so valuable for this region is its ability to thrive on land containing a considerable quantity of alkali. There are few cultivated crops that will stand as much alkali as this.

The injurious effects of too much water upon the growth of alfalfa is well illustrated by the conditions at present prevailing in a number of localities in Colorado, particularly in the southern part of the State. The soil, either from natural causes or as a result of the methods of irrigation practiced, has become saturated with water to within a short distance of the surface. As a consequence the roots of the alfalfa rot and the plants become sickly and finally die, rendering it impossible to produce anything like a permanent meadow. Here in Colorado, as well as in many other parts of this region, the best success is obtained with alfalfa on the bench lands. It is surprising what a small amount of labor is required to obtain a good alfalfa meadow in some portions of this region. For example, it is a common practice to give sage-brush land no more plowing or other preparation than is necessary in taking off the sage-brush. The brush is cut and grubbed out, raked up and burned, and the seed sown directly on the unplowed land, covered and watered. The soil is so loose as to require little or no stirring, and water is the only thing necessary to make it produce abundant crops of alfalfa. Of course more thorough preparation will give an evener and more lasting meadow, but the writer has seen many fine alfalfa meadows on land untouched by the plow except to make ditches for distributing the water.

RED CLOVER.

Next to alfalfa, red clover is the most widely cultivated leguminous forage crop in this region. It seems to be more generally grown in

Montana than in either Colorado or Wyoming, and its cultivation is chiefly confined to rich valleys and bench lands near the mountains where there is a good supply of moisture or where irrigation is practiced. It is usually grown with timothy and other meadow grasses, and is cut for hay or used as a soiling crop. Very fine crops are raised in central and southwestern Montana and in northern and central Colorado, and it is occasionally seen elsewhere in these States. Red clover is not generally grown in Wyoming, though it is being tried in many localities with very fair success. During the past season it was observed in successful cultivation in Crook, Johnson, Bighorn, and Uinta counties.

ALSIKE.

Although less commonly grown than red clover, alsike is certainly a valuable crop for many parts of this region. Many farmers who have grown them side by side prefer the alsike to the red clover as a forage crop for their respective localities. For example, Mr. C. C. Willis, of Horse Plains, Mont., writes that he much prefers alsike on account of its heavier yield of forage and greater drought-enduring qualities. Excellent fields of alsike and timothy were seen in 1896 in the Gallatin Valley, and reports of the successful growing of this clover have been received from various points in central and southwestern Montana, northern Wyoming, and northern and central Colorado. As a general thing the alsike seems to be hardier than red clover and is better adapted for permanent meadows, and some maintain that it does better on the heavy "gumbo" soil found in so many places in the Northwest. It has also given good results in many parts of the Dakotas, where it has received a thorough trial. It deserves more attention from farmers and ranchmen in the Northwest generally.

WHITE CLOVER.

It is rarely that this clover is sown in this region except on lawns or in dooryards, but its ability to gain a foothold and maintain itself among other vegetation is well shown in the fact that it is found everywhere in patches of various sizes along the margins of irrigating ditches, in waste places, and in pastures and meadows. Reports from several counties in central and western Montana and central Colorado indicate that it is occasionally sown in pastures and is growing in favor, more particularly for use in pastures for sheep and dairy stock. In extended trips through this region in both 1896 and 1897 the writer found but very few instances of its having been sown purposely in pastures, though it was often present even in native pastures in greater or less quantities.

The excellent showing made by this clover during the season of 1897 was very noticeable throughout the West and Northwest generally, particularly in the older-settled districts. In eastern South Dakota, northwestern Iowa, and eastern Nebraska this clover made a remarkable development. Almost everywhere along roadsides, in waste places, and in pastures could be seen the masses of white blossoms. Pastures in which scarcely an appreciable amount of the clover had ever been observed before were white with it. In many cases no clover seed has ever been sown in the pastures, but it has gradually worked in from accidental sources, and though the progress has undoubtedly been slow, it has nevertheless been sure, and this clover has come to occupy a very important place among the vegetation of the pastures. The tendency of white clover to develop in alternating periods of light and heavy growth has often been observed in the past, and its appearance in such quantity in the present instance is a good illustration of the changes in the composition of pastures that are going on constantly, though they are not always for the betterment of the pasture, as in this case.

MISCELLANEOUS FORAGE CROPS.

Aside from the preceding list of standard grasses and forage plants, there are a number of crops of greater or less importance that are grown in the various parts of the region. In most cases their cultivation is not general, sometimes because the plants are not well enough known and sometimes because of their inability to thrive under the conditions prevailing over a large part of the region.

In the dry portions of Colorado where irrigation is not practiced the sorghums, both saccharine and nonsaccharine varieties, are grown to some extent for winter forage and for soiling. The great drought-enduring qualities of the sorghums and their ability to thrive on land containing considerable alkali render them especially valuable for certain portions of this region. Mr. E. E. T. Hazen, of Phillips County, Colo., reports good success in growing several of the nonsaccharine varieties (yellow milo maize, brown doura, and Jerusalem corn), and S. Needham, of Prowers County, regards "sorghum as very valuable for winter forage on nonirrigable lands." Only the early maturing varieties like Early Amber are grown in Wyoming and Montana, and these not to any great extent.

The common cereal crops, such as rye, oats, wheat, and barley, are often grown for forage. Rye and oats are used for this purpose more often than any others, although it is a common practice to cut any cereal for hay if conditions are such that it is not likely to mature a crop of grain. Rye is being very successfully grown for late and early pasturage in many localities, and its cultivation is becoming more general each year. It is already quite extensively grown in central Colorado, northern Wyoming, and some parts of Montana. Sown in early autumn, it gets the benefit of the rains and snows of fall, winter, and early spring, and usually matures a fair crop of grain in addition to furnishing much pasturage, when spring-sown crops would fail unless artificially watered.

Other crops that have been grown in some parts of the region with success are field peas, rape, sand or hairy vetch, and esparcette. Particularly encouraging results are reported from central Colorado regarding the growing of field peas for forage, and the crop has done well in many other parts of the region. Profitable crops of rape, vetch, and esparcette are reported from Montana and elsewhere.

Millet is more generally grown for hay than any other annual. Common millet and Hungarian are usually preferred for the average uplands. Broom-corn millet is sometimes grown as a grain crop, but yields too lightly for a hay crop where the better varieties can be grown. As a general rule all the millets are used as "catch crops" rather than as regular crops, and as such they fill an important place in northwestern agriculture. They are most commonly grown in the northern part of the region.

NATIVE GRASSES AND FORAGE PLANTS.

There are about 270 species and varieties of grasses known to be indigenous to this region. Naturally a great majority of these are too small or too rare to be of much importance in the production of hay or pasturage. The most valuable species are quite widely distributed, although occasionally a species of but local occurrence may be of considerable importance in its particular locality, as is the case with some of those occurring in the mountains.

The great economic importance of the native grasses is at once apparent when one recalls the many thousands of sheep, cattle, horses, and mules that are raised in this region, and that depend entirely upon the native grasses and forage plants for subsistence for from eight to twelve months of the year. That the quality of the forage afforded is excellent is shown by the fact that most of the vast numbers of fat cattle and sheep annually shipped to the Eastern markets from this region receive no other food than that furnished by the natural meadows and pastures of the ranges.

From the economic point of view the important native grasses of this region may be classed into two groups, namely, meadow grasses and pasture grasses. To be sure, no hard and fast line can be drawn, but as a general thing the best pasture grasses are of little use for hay, and within late years, at least, wherever good hay-producing grasses occur in any great extent, they are fenced off from the open range and preserved for winter forage.

NATIVE MEADOW OR HAY GRASSES.

LOWLAND MEADOWS.

The grasses most abundant in the meadows at the lower altitudes are usually quite different from those which predominate in the mountain meadows, although it is seldom that any sharp line occurs where the strictly mountain grasses begin and the lower valley grasses leave off. The change is rather a gradual one. Hay meadows are almost entirely confined to the valleys of the larger streams, the prairies and hilly country being given over to grazing. Occasionally a rich plateau or "bench" may be found with a sufficient supply of moisture to produce a growth of grass luxuriant enough for hay, but these are rare. The grasses of most importance in the meadows in the lower valleys are wheat-grasses (*Agropyron* spp.), meadow-grasses (*Poa* spp.), manna-grasses (*Panicularia* spp.), sand-grasses or blue-joints (*Calamagrostis* spp.), and wild rye-grasses (*Elymus* spp.).

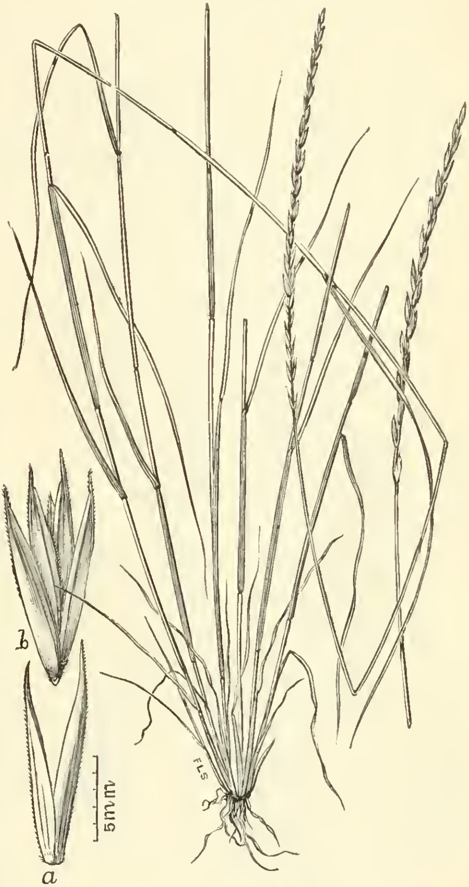

Fig. 8.—Slender wheat-grass (*Agropyron tenerum*).

Of these the wheat-grasses are by far the most valuable. A great many species occur in this region, but there are three which are of special importance as hay-producing grasses. These are Western wheat-grass (*Agropyron spicatum*), known also as Colorado blue-stem, slender wheat-grass (*Agropyron tenerum*) (see fig. 8), and false quack-grass (*Agropyron pseudorepens*). These grasses are very generally distributed over the region, and grow naturally on a great variety of soils. All respond readily to cultivation. Usually all that is necessary to convert a piece of good sage-brush or valley land into a wheat grass meadow is to clear off the brush and large stones, keep off the stock, and water the land. The grasses will soon take complete possession. On nearly every well-kept ranch in the eastern Rocky Mountain region can be seen fine natural meadows made in this manner. Western wheat-grass is usually more abundant than either of the other sorts, and it is not an uncommon thing to see a meadow of 40, 80, or more acres composed almost exclusively of this grass. Without irrigation it is rarely possible to cut more than one crop in two years, as the grass requires time to recuperate. Even with irrigation it is seldom possible to obtain good crops for many consecutive years without cutting up the sod to overcome its "hidebound" condition and give opportunity for the growth of new shoots. Under favorable conditions, however, these meadows may yield good crops for a number of years with nothing more than proper watering. Mr. Griffiths reports seeing a meadow of about 40 acres the past season, near Snoma, S. Dak., yielding a crop of about 2 tons of hay per acre, which had afforded a good crop for five consecutive seasons.

In the wet or boggy places in lowland meadows the wheat-grasses are replaced principally by the meadow-grasses and, if the soil is sandy, the sand-grasses or blue joints are often present in considerable quantity. Of these grasses reed meadow- or manna-grass (*Panicularia americana*) (see fig. 9) and nerved manna-grass (*P. nervata*) are common in very wet boggy places unless the soil is too strongly impregnated with alkali, when they are often replaced by alkali meadow-grass (*Puccinellia airoides*). This last grass is usually quite rigid and wiry and grows in close bunches, but furnishes considerable forage in some localities. Often it is about the only grass to be seen among the sedges and rushes of the wet, alkali meadows, and in such places it is more succulent and palatable than when growing in drier situations. It is very abundant in the overirrigated meadows along the Little Laramie River in Wyoming, and is quite widely distributed over the Western plains and throughout the valleys in altitudes below 8,000 feet.

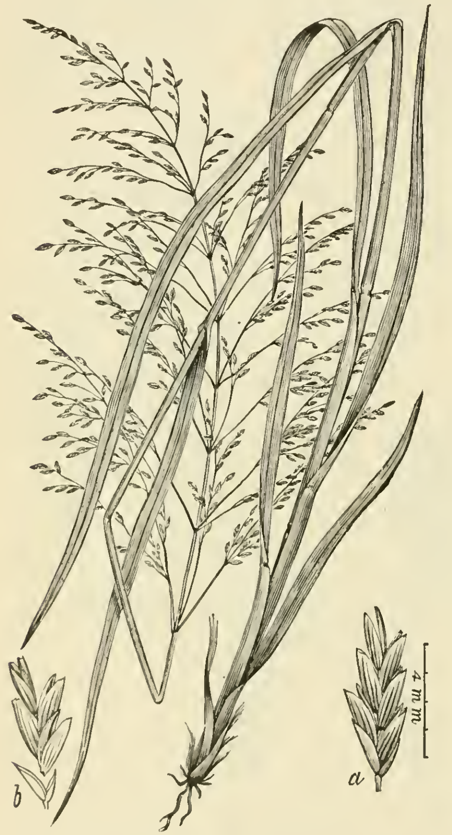

FIG. 9.—Reed meadow-grass (*Panicularia americana*).

The true meadow-grasses (*Poa* spp.) are of much more value generally than those just mentioned. These are most abundant in the moist meadows near the foot of the mountains. Among the valuable kinds are the indigenous forms of Kentucky blue grass (*Poa pratensis*), the "bunch-grasses" (*Poa buckleyana*, *P. laevigata*, and *P. lucida*), Wyoming blue grass (*P. wheeleri*), bench-land spear-grass (*P. arida*), woodland meadow-grass (*P. nemoralis*), Nevada blue grass (*P. nevadensis*), and fowl meadow-grass or false redtop (*P. flava*). Many of these are of as much importance, under present conditions, for pasturage as for hay, but with a proper supply of water all afford good yields of excellent hay. In the valleys Kentucky blue grass, in either its native or introduced form, is perhaps most commonly seen, and is becoming more and more abundant as the country is settled up and the native meadows brought under irrigation.

Of the "bunch-grass" *Poas*, *P. buckleyana* (fig. 10) is apparently the most widely distributed, being, if anything, more common on the dry uplands than in the valleys, and hence perhaps more properly to be regarded as a pasture grass. However, under irrigation it becomes less densely tufted, the leaves are broader and more luxuriant, and the yield of hay is good. Smooth bunch-grass (*P. lævigata*) and pale bunch-grass (*P. lucida*) are more often found in the lowlands and are excellent meadow grasses. They are most abundant in the middle Rocky Mountain region.

Wyoming blue grass is often found with Kentucky blue grass in moist meadows and along banks of streams, but it ascends higher up the mountains, where it is frequently abundant in open pine and spruce woods, sometimes occurring in dry situations, but generally where the soil is well supplied with moisture. It is especially abundant in parts of Wyoming and central Montana, usually occurring at an altitude of from 6,000 to 8,000 or 9,000 feet, but sometimes ascending to 10,000 feet. In the rich moist soil of "burn outs" in pine and spruce woods it makes a magnificent growth.

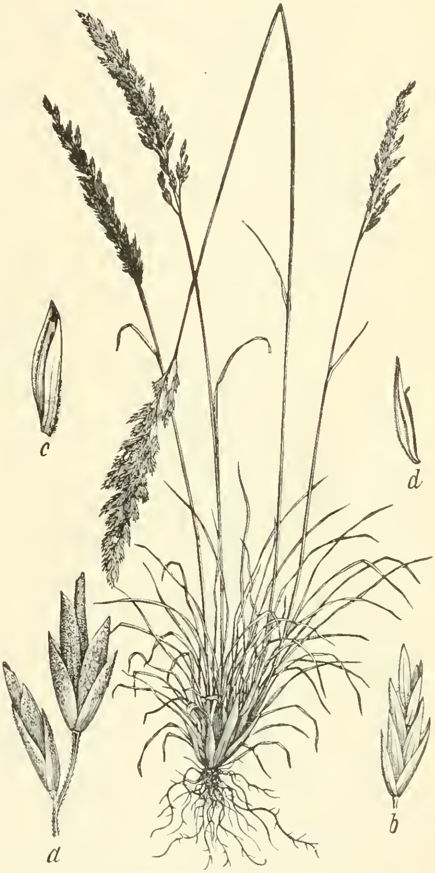

FIG. 10.—Bunch-grass (*Poa buckleyana*).

Bench-land spear-grass (see fig. 11) is quite generally distributed throughout this region. It usually occurs in rather dry meadows, often in patches of considerable extent, but never forming a close sod, as does Kentucky blue grass. The forage is of poorer quality than that furnished by the latter and the yield is lighter. However, the grass is one of the earliest of the native species and thrives better on dry soil than Kentucky blue grass. Under cultivation it would probably be more valuable for pastures than for meadows.

There are few of the native meadow-grasses that grow naturally under such a wide range of soil and climatic conditions as woodland meadow-grass in its several varieties. It is common in woodlands along the prairie streams, and follows up the valleys into the foothills and mountains, where it becomes an important element in the moist meadows. It also occurs on rocky hills and mountain sides, some of its forms flourishing at an altitude of 10,000 feet, or even more, in Colorado. Some of the forms growing in the rich lowland meadows approach fowl meadow-grass in size and appearance, and afford a large amount of excellent hay.

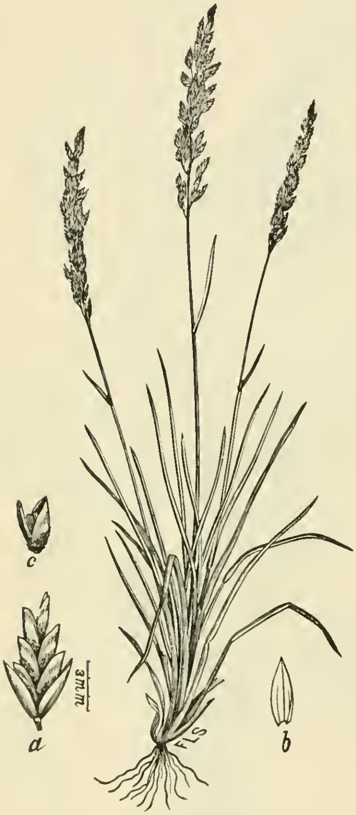

Fig. 11.—Bench-land spear-grass (*Poa arida*).

Nevada blue grass (fig. 12) is more common on the west side of the Continental Divide than on the east, but it is nevertheless sufficiently abundant in the latter region to form an important part of the vegetation in many of the natural meadows. It occurs as far east as the Pine Ridge of Nebraska and the Black Hills of South Dakota, but is most abundant in the valleys among the foothills and mountains. Some forms of it grow on rather dry soil in open woodlands and on rocky mountain sides. It prefers rich soil with a medium supply of moisture and does well under irrigation. Under favorable conditions it makes an excellent growth of leaves, and yields a large amount of hay compared with most of the native species of *Poa*. It is rarely found above an altitude of 8,000 or 9,000 feet in this region.

Fowl meadow-grass is not as abundant in the immediate vicinity of the mountains as it is farther to the eastward, but nevertheless is found quite plentifully in certain localities. It occurs most frequently along streams about the edges of thickets, and on moist banks and bottom lands subject to overflow in the early part of the season. For such places it is a valuable grass, making a good yield under conditions that would "drown out" most of the common grasses. It is much more valuable for hay than for pasturage. In some localities this grass is called false redtop.

The sand-grasses or blue joints found in the meadows are remarkable for their abundance of long root-leaves and the consequent large yield of hay, which is usually of an excellent quality. One of the most widely distributed species is the common blue joint (*Calamagrostis canadensis*), locally known as false or native redtop. This grass is often very abundant in moist, sandy river bottoms, and some of its many forms ascend well up into the mountains. It has been cultivated with good success and is worthy of extended trial in the Northwest.

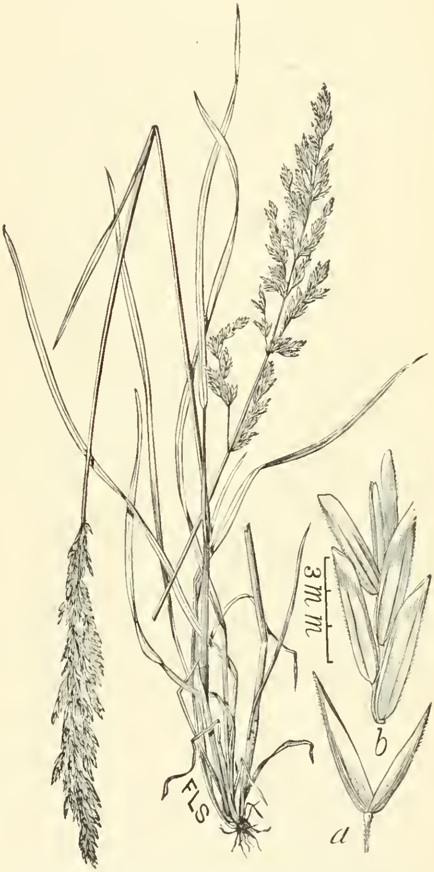

Fig. 12.—Nevada blue grass (*Poa nevadensis*).

Sand-grass or yellow-top (*Calamagrostis americana*) is also well distributed throughout this region. It is most commonly found along the sandy banks of streams, ponds, and lakes, often (especially along sloughs) forming a well-defined "yellow-top" zone of vegetation, noticeable from a considerable distance because of the characteristic color of the grass. It seems to thrive better in alkali soils than its relatives, and is generally confined to comparatively low altitudes.

Big sand-grass (*Calamovilfa longifolia*), although common on the plains and in the valleys throughout, is not so valuable as the preceding species because of the very coarse and fibrous nature of the forage which it produces. It is most commonly found in dry, sandy swales and on sandy hillsides, and in the bad lands and other dry districts, where the better grasses are scarce, it is often plentiful. In such localities it is regarded as a valuable grass, and is used for hay.

There are several of the wild rye-grasses that occur in sufficient quantities to be of importance in the vegetation of the native meadows. All are most abundant as a rule in rich, open, rather dry meadows and on hillsides, and are rather coarse, harsh plants, affording considerable hay of an average quality. The kinds of most importance are common wild-rye (*Elymus canadensis*), Macoun's rye-grass (*E. macounii*), and giant rye-grass (*E. condensatus*). The first of these is the most generally distributed, and is probably the most valuable, although the second, which is also quite common, is a finer grass and produces a better quality of hay.

Giant rye-grass is a tall, coarse species, growing in large clumps, found in sandy or gravelly soil of meadows and hillsides. It is too harsh and woody to be relished by stock, and is seldom eaten except when young, or in winter, when other forage is scarce or when the snow is deep. Owing to its habit of growing in such dense bunches it is difficult to cut for hay. However, when better grasses are scarce it is frequently cut early, and the hay is said to be of fair quality. When a meadow becomes thickly seeded to this grass and is cut or burned closely for several seasons a fairly even sod is produced, and such a meadow is of considerable value, particularly when, as is usually the case, the better grasses can not be grown because of adverse soil or climatic conditions. Such meadows are much more common on the west side of the Continental Divide than on the east. During the summer of 1896 a number of such meadows were seen in southwestern Montana and eastern Idaho, and in 1897 several were seen in northwestern Wyoming. This grass usually ripens a large amount of seed, and stock gets a great deal of nourishment by eating the seed-heads in fall and winter. Horses are said to be particularly fond of them.

On the eastern edge of this region Virginian lyme-grass (*Elymus virginicus*) is quite common in some localities, but is more valuable for early pasturage than for hay.

Among other native grasses that may be mentioned as of value in native meadows, but which only occasionally occupy any prominent place in them, are bearded wheat-grass (*Agropyron richardsoni*), in rather dry meadows; the cord-grasses (*Spartina cynosuroides* and *S. gracilis*), in sloughs and low places, the latter in alkali situations, particularly; slough-grass or wild timothy (*Beckmannia erucæformis*), along sloughs and irrigation ditches and in wet meadows, becoming very abundant in many parts of the region; and reed canary-grass (*Phalaris arundinacea*), abundant in places, and particularly valuable in wet meadow lands and sloughs.

MOUNTAIN MEADOWS.

The mountain meadows, so numerous in portions of this region, differ considerably in the composition of their vegetation from those of the lower valleys and plains discussed in the previous pages. Here the true meadow-grasses form the predominating element, replacing the wheat-grasses of the lower meadows; the brome-grasses (*Bromus* spp.), seldom seen at the lower altitudes, are here abundant; the tussock-grasses (*Deschampsia* spp.) are plentiful everywhere in wet, boggy situations; and the blue joints (*Calamagrostis* spp.), alpine timothy (*Phleum alpinum*), mountain foxtail (*Alopecurus occidentalis*), the wild oat-grasses (*Danthonia* spp.), rough-leafed bent (*Agrostis asperifolia*), and red fescue (*Festuca rubra*) are all valuable members of the vegetation of these meadows.

Of the blue grasses (*Poa* spp.) several of those mentioned in the foregoing discussion are common in the mountain meadows, namely, Wyoming blue grass (see fig. 13), smooth bunch-grass, Nevada blue grass, and woodland meadow-grass. In the higher altitudes alpine blue grass (*Poa alpina*) and mountain meadow-grass (*Poa leptocoma*) are the predominating species. An interesting thing in connection with the distribution of these two grasses was observed in northern Wyoming the past season. In the Bear Lodge range, in northeastern Wyoming, alpine blue grass was frequently met, and it was also very abundant in the mountains at the head of Meeteetse Creek in the northwestern part of the State, but extended search failed to reveal any of this grass in the Big Horn Mountains in the north central part of the State and nearly midway between the other two localities. Mountain meadow-grass was very abundant in the Big Horn Mountains, and was also found in the mountains at the head of Meeteetse Creek, but was not seen in the northeastern part of the State. Alpine blue grass is most abundant in sandy or gravelly soil near the streams, and mountain meadow-grass prefers cold, wet, boggy meadows and mountain sides.

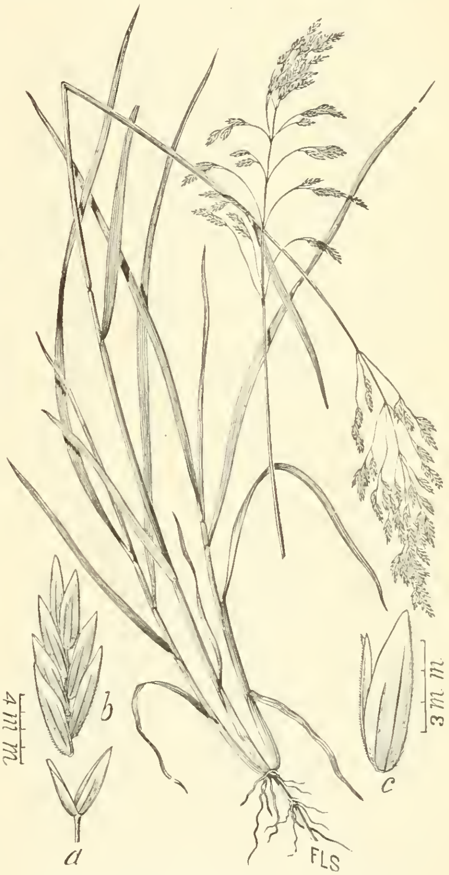

FIG. 13.—Wyoming blue grass (*Poa wheeleri*).

Alpine timothy is very widely distributed at the higher elevations in the Rocky Mountain region. It is quite abundant in the Black Hills above 6,000 feet. In the Big Horn Mountains it vies with tussock-grass for first place in many of the meadows at 7,000 to 8,000 feet, particularly on the western side of the range, where it is much more abundant than on the eastern slope. In central Montana it is most plentiful at and above 6,500 feet, rarely occurring below 6,000 feet, the ordinary limit for common timothy. It is rarely found below 9,000 feet in Colorado, except, perhaps, in the northern part of the State, but is plentiful up to 13,000 feet. Hay made from this grass is highly prized by ranchmen, especially for horses.

Mountain foxtail (fig. 14), which is also sometimes called mountain timothy, has much the appearance of true mountain or alpine timothy, but is usually more robust and of a softer texture and produces a better looking hay, much like that from the cultivated meadow foxtail (*Alopecurus pratensis*), which this grass resembles in habit of growth. Although found throughout the Rocky Mountain region, and having similar altitudinal limits, it is much less common as a rule than alpine timothy. It is abundant in the rich, moist meadows of the Spanish Basin and elsewhere in southwestern Montana, and makes a remarkably luxuriant growth, frequently reaching a height of three or four feet, and is one of the most promising of the native grasses for cultivation in meadows at the higher altitudes.

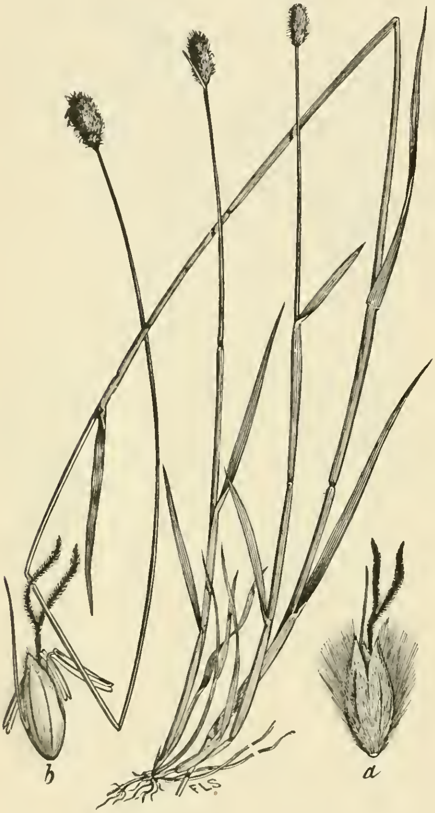

FIG. 14.—Mountain Foxtail (*Alopecurus occidentalis*).

Several of the native brome-grasses are of great value in the native meadows at an altitude of from 5,000 to 8,000 feet in Wyoming and Montana and from 6,000 to 9,500 in Colorado. The most valuable of these brome-grasses are short-awned brome (*Bromus breviaristatus*) (see fig. 15) and Western brome (*Bromus pumpellianus*). Both are coarse-growing perennials and occur throughout the Rocky Mountain region, chiefly in the rather dry valleys and "parks;" the former selecting the moister situations and the latter the drier ones. Although they are often found growing together, Western brome-grass seems to have a somewhat higher altitudinal limit, its point of best development usually ranging from 500 to 1,000 feet above that of short-awned brome. The latter is occasionally abundant down as low as 4,000 feet in central Montana, while the former is but rarely found at that altitude. In northern Wyoming short-awned brome is most abundant at from 5,000 to 7,000 feet and Western brome at from 6,000 to 8,000. Both of these grasses have been cultivated in some parts of the Northwest with success and promise to be valuable for meadows at high altitudes. Western brome has very much the same appearance and habit of growth as the recently introduced smooth or Hungarian brome which is being grown with such excellent success in the semiarid West and Northwest.

Tussock-grass (*Deschampsia cæspitosa*) is perhaps the most abundant and widely distributed grass in the native meadows of the Rocky Mountain region. It has a very wide altitudinal range. For example, it is abundant in wet meadows in the Gallatin Valley about Bozeman, Mont., at an altitude of about 4,000 feet, and ascends to above the timber line in the mountains on either side of the valley. On account of its tufted habit of growth it does not form an even sod, and hence does not make a good meadow by itself. In most instances, however, it is accompanied by other grasses, such as the true meadow-grasses, redtop and blue joint, which fill in the spaces between the tufts, making a fairly good meadow sod. Some observers have reported this grass as of no practical value for either hay or pasturage, but such statements are not borne out by the reports of our field agents nor by the opinions advanced by the ranchers.

While neither the yield nor the quality of the forage is equal to that obtained from timothy or redtop, there can be no doubt that the grass fills an important place among the native meadow and pasture grasses of this region. It flourishes in wet, boggy places where many of the better grasses can not grow, and by its dense tufts of tough fibrous roots helps to convert these bogs into usable meadow lands. Moreover, continued mowing and pasturing have the effect of reducing these tufts materially, so that with a few other grasses to act as fillers a comparatively even sod is produced. Such a condition of things may be seen in many of the mountain valleys, as, for example, in the valley of the Little Laramie River near Sheep

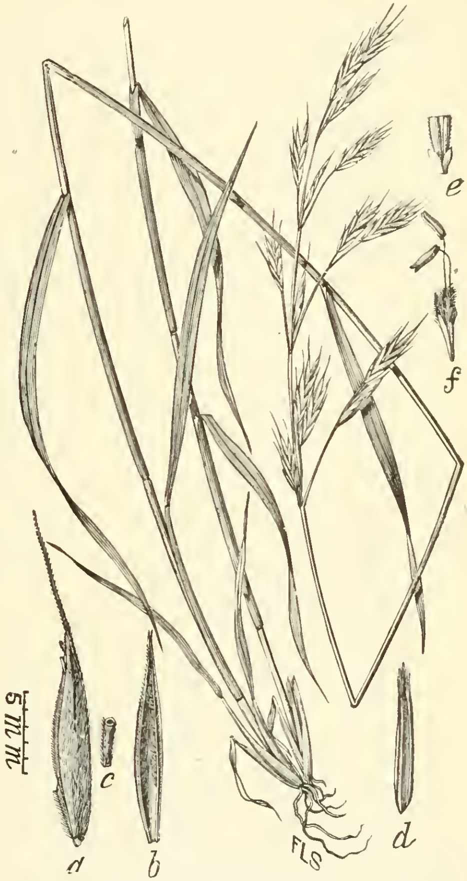

FIG. 15.—Short-awned Brome-grass (*Bromus breviaristatus*): *a*, the floret seen from the side; *b*, palea; *c*, joint of the rachilla; *d*, grain; *e*, lower portion of pistil, showing lodicules; *f*, young seed or grain.

Mountain. In the varieties of tussock-grass growing in the higher altitudes the leaves become considerably reduced, and, of course, produce little forage of any sort, but the varieties growing in the meadows at from 4,000 to 6,500 feet develop a much greater leafage and afford a large amount of hay and pasturage.

A form of red fescue is not uncommon in the moist meadows at from 4,000 to 9,000 feet altitude in the northern part of the Rocky Mountain region, and is of much value for hay in some localities. It seldom forms tufts of any size, spreads by means of very slender underground stems, and is usually found mixed with other grasses. It is quite abundant in the Spanish Basin and elsewhere in southwestern Montana, and also in the Big Horn and Shoshone mountains in Wyoming.

Rough-leafed bent occurs naturally in wet, boggy meadows and along banks of streams and ditches. The best hay-producing forms occur at elevations of from 4,000 to 6,000, or occasionally 7,000, feet. This grass produces an abundant leafage, much more than the common redtop, and also produces a large amount of seed—two things very desirable in a grass for cultivation. In the wild state it seems to be even more hardy than redtop, and while flourishing best with plenty of water it will, nevertheless, endure considerable drought when once firmly established. It is quite an important element in the native meadows in portions of northern Wyoming and central and southern Montana, and is perhaps more common on the west side of the Continental Divide than on the east. As ordinarily seen in the natural condition, rough-leafed bent has a closely tufted habit of growth, but when thickly seeded, as when in cultivation or occasionally in native meadows when conditions are favorable, this habit is largely lost, and a fairly even sod is formed. Its good qualities as a meadow grass commend it to those experimenting with our native species. It will doubtless be found to be better adapted for meadows at higher altitudes than most of the common so-called tame grasses.

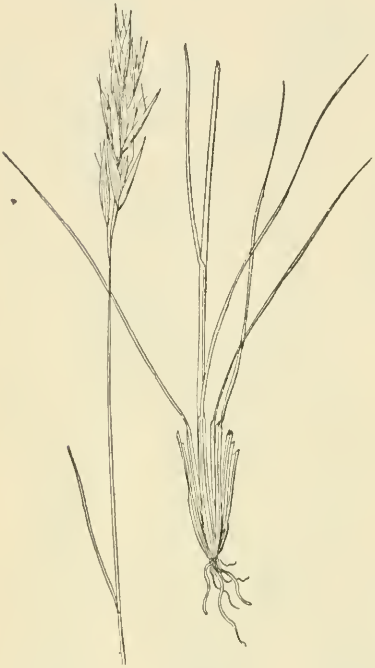

FIG. 16.—Rocky Mountain oat-grass (*Danthonia intermedia*).

There are several of the oat-grasses found in greater or less abundance in the meadows and "parks" of the mountains and foothills of this region. The most important are Californian oat-grass (*Danthonia californica*), Rocky Mountain oat-grass (*Danthonia intermedia*) (see fig. 16), and Parry's oat-grass (*Danthonia parryi*).

As a rule these oat-grasses occur naturally in rather dry meadows and on mountain sides, Californian oat-grass being more inclined to seek moist situations than either of the others. It is the largest of the native oat-grasses, reaching a height of 3 feet under favorable conditions, and is also the most abundant Northwestern species. In northern Wyoming and Montana it forms a considerable portion of the meadow vegetation at from 5,500 to 8,000 feet. It is occasionally found as low as 5,000 feet, but is most abundant at from 6,000 to 7,000 feet. On rich, irrigated meadows it makes a very fine growth. It is rarely found as far south as Colorado, where it is replaced by Parry's oat-grass.

Rocky Mountain oat-grass is often found growing along with Californian oat-grass; but it is a smaller plant, preferring rather drier soil and having a somewhat higher altitudinal range—seldom occurring below 7,000 feet, abundant at 8,000 to 10,000 feet, and ascending to 11,000 feet or even 12,500 feet in Colorado. It is probably of more value for pasturage than for hay.

Parry's oat-grass is most abundant in the park region of Colorado, but also occurs in southern Wyoming. Although occurring naturally in rather dry meadows and on mountain sides, it makes a fine growth under irrigation and is occasionally found in some quantity in timothy meadows. It has a much more tufted habit of growth than Californian oat-grass and its altitudinal range—from 7,000 to 10,000 feet—corresponds very well to that of its more northern relative. Although of local occurrence it is abundant in places, sometimes almost completely occupying the open woods and parks in the mountains of central Colorado.

The blue joints are usually conspicuous elements in the vegetation of the moister mountain meadows. They are the chief grasses in many of the deer parks in the higher mountains, and are particularly abundant in the wet, boggy, open aspen thickets so frequently found in the Northwest. There are about a half-dozen species which are found in sufficient quantities to be of importance as forage producers. By far the most abundant is mountain blue-joint (*Calamagrostis canadensis acuminata*), a near relative of the common blue joint, which it replaces in the higher altitudes. It produces a large amount of excellent hay in the wet, sandy or gravelly valleys along the mountain streams, and usually occurs at an altitude of from 5,000 to 8,000 feet in the North, but ascends to 10,000 or rarely to 11,000 feet in Colorado. In northern Wyoming and central and southern Montana it makes an enormous development in the rich, moist soil of some of the mountain parks, frequently covering areas several acres in extent with a dense growth, reaching a height of 3½ or 4 feet.

Northern blue joint or Langsdorff's reed-bent (*Calamagrostis langsdorffii*) is often found growing along with mountain blue joint and has a similar range, but is much less abundant and has rather higher altitudinal limits. In localities where it is plentiful it is highly prized by stockmen, by whom it is often called "purpletop" on account of the prevailing color of the inflorescence. It is much more common to the northward, being but rarely found as far south as Colorado, and then only in the higher mountains.

Other blue joints deserving special mention are Scribner's blue joint (*Calamagrostis scribneri*) and Suksdorf's blue-joint (*C. suksdorfii*). Both are northern in distribution, the latter being found in this region only in central and western Montana and most abundant west of the Continental Divide, and the former reaching down into central or rarely into southern Wyoming and Colorado. Both have an altitudinal range of about 3,000 feet, seldom occurring below 5,000 feet or above 8,000 feet in Wyoming and Montana. Suksdorf's blue joint, although reaching its best development in the moist land of the valleys, is often found on the drier ridges and mountain sides.

NATIVE PASTURE GRASSES.

Naturally much the greater portion of the grass land is used for grazing. At the present time nearly all the land not under irrigation is used for this purpose. This includes by far the larger part of the upland prairies, the bad lands, the broken foothill country, and the accessible mountainous country.

Some of these pasture lands, notably those in the mountains and higher foothills, can be used during only a portion of the year, but the remainder are grazed through the entire year. In some localities certain portions of the range are protected during the growing season in order that the grass may make a good growth and furnish forage for fall and winter grazing. Sometimes the stock is kept from these areas by fencing, but often the ranchmen, by common consent, keep the stock on other ranges during the summer, and bring it to the protected areas only when forced to do so by the approach of severe winter weather. In localities where the meadow lands and winter pastures are fenced in, the open range is usually in very bad condition. Every ranchman is eager to get his "share" of the open and free range, and naturally turns out all his stock during the summer. As a result, the grasses and better forage plants are eaten up or trampled into the ground before the end of the season. What wonder that the grasses are dying out on the open range! The wonder is that they have survived as long as they have. During the past season, while making wagon trips through the Belle Fourche and Big Horn Basin countries, it was often necessary to drive many miles in order to find sufficient pasturage for the team. All the grass lands not under fence were picked bare in July and August, and it was impossible to get feed along the trail except by obtaining permission of the ranchers to camp inside the inclosures. Of course the grasses are being preserved within the fenced areas, but these compose but a relatively small part of the total pasture lands, and the get-all-you-can system is rapidly and certainly ruining the open range. In parts of the range region the scarcity of stock during the past few years, together with a few favorable growing seasons, has allowed the grasses to recuperate somewhat, but already the stockmen are beginning to increase their herds in order to be able to take advantage of the anticipated rise in prices of beef cattle, mutton, and wool, and there is danger that those lands not already overstocked will soon be so unless something can be done to convince these stockmen of the shortsightedness of such a policy.

In the higher foothills and mountains the pasturage is generally in good condition—much better than on the prairies. There are two principal reasons for this. In the first place, there is usually a good supply of moisture, and in the second place, the lands can be grazed during only a portion of the year on account of the heavy snowfall. As the lands can be grazed for but four or five months of the year at the outside, there is a long period during the early part of the season when the grasses make a considerable growth, so that they are already well along in the season's development, sometimes maturing seed, before grazing begins.

GRASSES OF THE PLAINS.

Out on the open ranges of the plains, however, there are few localities in which the pasturage is anything like as good as in former years. Leading stockmen from nearly all parts of the plains region estimate that the stock-carrying capacity of the pasture lands has been reduced on the average from 40 to 50 per cent in the last ten or fifteen years. The real reason for this is overstocking. The real stock-carrying capacity of a given area of pasture lands is the amount of stock that can safely be grazed on it during a dry or unfavorable season; and if these lands are to be kept in proper condition this limit should never be exceeded except perhaps temporarily during particularly favorable seasons; and the number of stock should be reduced as soon as it is seen that the grasses are being grazed too closely. Under the present system, or rather lack of system, of controlling the open grazing lands, it is hardly to be expected that the ranchman will do otherwise than to continue to try to get his "share" of the forage on the open range, and in so doing will continue to add to its already overburdened condition.

There are many thousands of acres of the public lands in this region that are of more value for grazing than for any other purpose, and in view of their importance and of the great danger of permanent injury resulting from the present methods of grazing it would seem urgent that some rational system of controlling them should be devised and adopted at once.

All the native grasses are grazed by stock to a greater or less extent, but many kinds are too small to afford much forage; others are too coarse and woody, or otherwise unpalatable, to be of much value; and still others, while affording nutritious forage, are of most value for hay, and have been considered in the preceding pages of this report under the discussion of the native meadow-grasses.

The principal pasture grasses of the dry plains region are the gramas (*Bouteloua* spp.), buffalo-grass (*Bulbilis dactyloides*), wheat grasses, already discussed under meadow-grasses, prairie June-grass (*Koeleria cristata*), and needle-grasses (*Stipa* spp.). Other grasses of considerable value for grazing, but of more or less local distribution, are Indian millet (*Eriocoma cuspidata*), rush-grasses (*Sporobolus* spp.), Montana sand-grass (*Calamagrostis montanensis*), salt-grass (*Distichlis spicata*), and several of the bunch-grasses and wild ryes already mentioned.

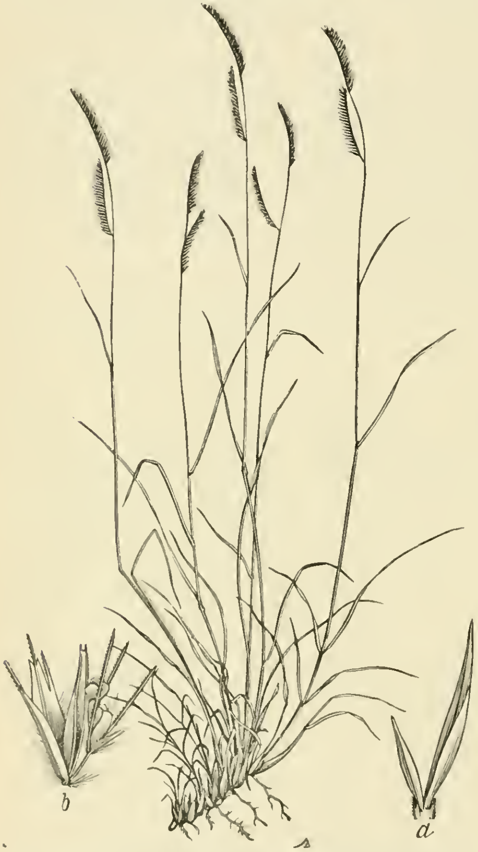

FIG. 17.—Blue grama (*Bouteloua oligostachya*): *a*, empty glumes of a spikelet; *b*, spikelet with the empty glumes removed.

There are three gramas found in this region, and all are valuable pasture grasses. The best, and by far the most abundant, is blue grama (*Bouteloua oligostachya*). (See fig. 17.) It is one of the most generally distributed grasses of the prairies, and also occurs in considerable quantities on the higher bench lands and mesas, in the foothills, and in dry soil here and there in the lower mountain valleys. Everywhere it is regarded as an exceedingly valuable grass for both summer and winter pasturage, but particularly for the latter, vying with buffalo-grass for first place. At the present time it is probably of greater actual value on account of its more general occurrence, greater yield of forage, and greater ability to hold possession of the soil under excessive pasturing and extreme drought. In the rather loose, sandy soil, so common to the prairies of this region, blue grama forms closely sodded areas of varying extent which, on account of the purplish color of the foliage, stand out in strong contrast to the prevailing pale color of the remaining grass vegetation. Often these areas may be found alternating with similar areas of the much paler buffalo-grass, and the checkerboard appearance thus given to the prairie is peculiarly striking. Although primarily a pasture grass, blue grama, under favorable conditions of soil and moisture, makes a fine growth of leafage sufficient to afford a good yield of hay of a very fine quality. Under ordinary conditions, however, this grass cures so well on the ground that stockmen prefer to use it for winter pasturage rather than go to the trouble of putting up the hay.

Black grama (*Bouteloua hirsuta*) is much more local in distribution than blue grama, to which it is very similar in appearance and habit of growth. It is confined largely to rather limited areas on sandy or gravelly knolls and hillsides, and is valuable chiefly because it thrives in these poor soils, furnishing considerable pasturage where but few other grasses can do more than simply exist.

The third grama found in this region that deserves special mention is tall or side-oats grama (*Bouteloua curtipendula*). (See fig. 18.) It is a larger grass than either of the foregoing, and, while occurring throughout, is more abundant in the rich prairie soil of the eastern portion of the region. It produces a fine growth of long, slender leaves and on good soil makes a good yield of hay. In Nebraska and the Dakotas, where this grass is very abundant, it is regarded as of more value for hay than for pasturage, as it yields well, and the tough, rather harsh leaves are more readily eaten by stock as hay than when in the fresh state. In the principal range region, however, the grass is seldom present in much quantity, and on the drier soils the growth is not sufficient for hay; but it cures well on the ground and is readily eaten by range stock which are more accustomed to feeding on harsh herbage.

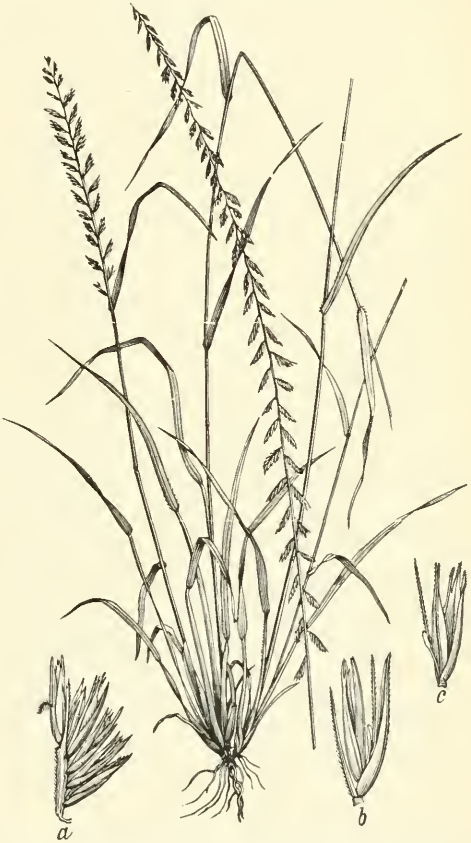

FIG. 18.—Tall or side-oats grama (*Bouteloua curtipendula*): *a*, one of the short spikes; *b*, a spikelet; *c*, a spikelet with the outer empty glumes removed.

There is no other grass which has a reputation for excellence for both summer and winter pasturage equal to that of buffalo-grass. However, not all of the praise bestowed upon this grass really belongs to it, for the gramas are often confused with it, and to them, particularly to blue grama, belongs much of the credit given to buffalo-grass in many parts of the range region. In the minds of many ranchmen "buffalo-grass" includes blue grama and black grama as well as the true buffalo-grass (*Bulbilis dactyloides*), while in the minds of others grama or "grammer," as it is often pronounced, includes all three.

However, there is no doubt of the great value of the true buffalo-grass for pasturage. That it is one of the most palatable of native grasses is shown by the fact that, with plenty of other grasses on every hand, stock will keep it eaten close to the ground, and this is probably the reason that it is one of the first grasses to be killed out in overstocked ranges. It is reported to have practically disappeared from many places where it was formerly one of the commonest species, but while this is no doubt true of some localities, it is certainly not true of all. Examination has shown that it is still quite abundant in some of these localities, but is easily overlooked, as it is kept grazed so closely that it is seldom able to make enough development to show its characteristic habit of growth, much less to bloom and mature seed.

The wheat-grasses usually furnish a larger percentage of the pasturage on the prairies than is generally supposed. The most valuable varieties for grazing are provided with underground stems or rootstocks, which run along a short distance below the surface and at frequent intervals send up erect branches, either bearing only tufts of leaves or more rarely producing "heads." When too closely grazed, or during unfavorable seasons, much of the growth of the plant is made by these underground stems and very few, if any, fertile branches are developed. On this account many people have an idea that these grasses grow only once in every two or three years, when as a matter of fact the actual yield of forage may be almost as much for an "off" year as for any other. Although regarded primarily as meadow or hay grasses, the wheat-grasses furnish a large part of the pasturage throughout the entire range region, and on the more strongly alkaline soils are often the only grasses of any value to be found at all.

The needle-grasses (*Stipa* spp.) are among the most conspicuous members of the grass vegetation of the plains and lower mountains and foothills. All produce a relatively large amount of leafage, which makes an excellent quality of forage. During the late summer, when the seed is maturing, some of the needle-grasses cause much trouble and often severe injury to stock, particularly to sheep, as the sharp-pointed needles or "spears" work into the flesh of the animals, making painful sores and sometimes causing the death of the animal. In some of the best forage-producing species the "spears" are very blunt, and hence do little or no damage. Where the range is kept closely grazed the plants seldom seed in sufficient quantity to be troublesome. As soon as the seed ripens the "spears" fall and work into the soil, so that these grasses can be used for hay or late grazing.

The common needle-grass (*Stipa comata*) of this region is valuable for both hay and pasturage. On poor rocky or gravelly soils, where it is one of the characteristic species (see fig. 19), it affords a large amount of pasturage, and on the rich prairie soils it makes a good yield of hay which is considered by many ranchmen to be equal in quality to "bluestem" or wheat-grass hay. Here in the range region it takes the place of porcupine-grass (*Stipa spartea*), so abundant in the Lower Missouri Valley region, but which only occurs in any considerable quantity along the eastern limits of the range. In some parts of the range, as for example in some localities of central and northern Wyoming, the common needle-grass sometimes composes the entire grass vegetation of the sage-brush prairies.

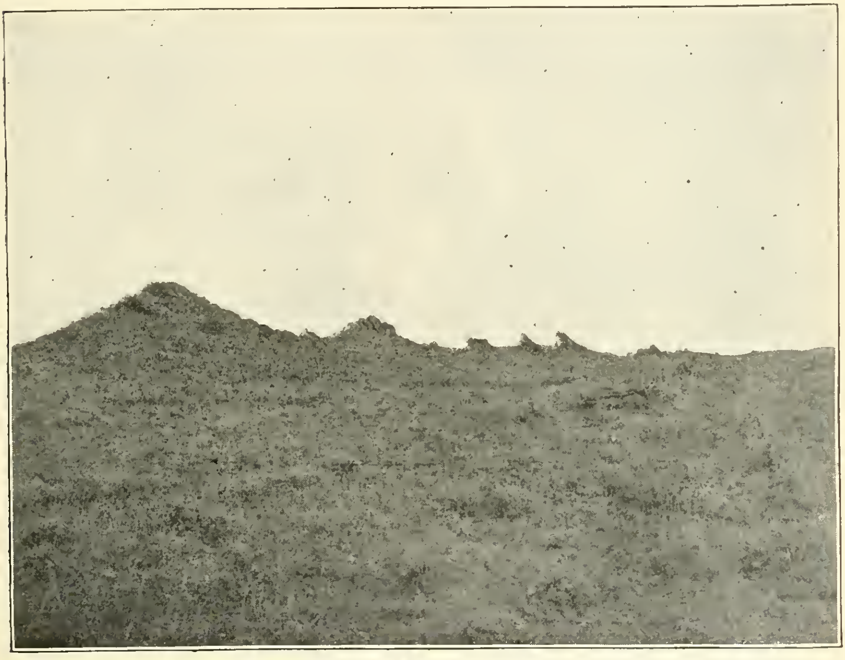

FIG. 19.—A bit of the "range" in N. E. Wyoming. (Photographed by David Griffiths.)

Another of the needle-grasses common in some of its many forms in this region is that most commonly known as feather bunch-grass (*Stipa viridula*). This is usually found in rather dry sandy soil, and forms dense tufted masses of leaves and stems, which afford good grazing. On account of its very blunt-pointed "spears" it seldom does any damage to stock and, as it endures close feeding well, it is one of the most desirable of the needle-grasses for grazing. Because of its densely tufted habit of growth and less luxuriant production of root leaves it is of less value for hay than common needle-grass. Nelson's needle-grass (*Stipa nelsoni*) and purple-top needle-grass (*Stipa minor*) are also of value for pasturage, but both belong more properly, perhaps, to the higher altitudes. On the Big Horn ranges, at about 8,000 feet altitude, purple-top needle-grass is an important pasture grass and is also frequently cut for hay.

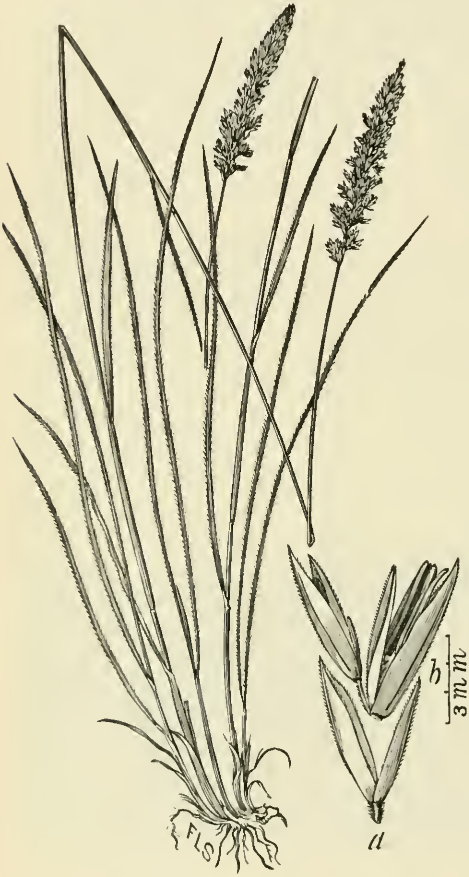

Fig. 20.—Prairie June-grass (*Koeleria cristata*): *a*, empty glumes; *b*, the two florets raised above the empty glumes.

Sleepy-grass (*Stipa vaseyi*) is quite abundant in the southern part of the eastern Rocky Mountain region. It takes its common name from the fact that in some localities it is thought to have a narcotic effect upon stock eating it. It is a coarse-growing grass, and the forage could hardly be very palatable in any event. However, in times of scarcity of pasturage it is quite closely grazed, in central Colorado at least, but whether with any ill effects has not been definitely ascertained. It is possible that the narcotic principle is not everywhere produced in injurious quantities.

One of the best early pasture grasses on the range is prairie June-grass (*Koeleria cristata*). (See fig. 20.) It is widely distributed, flourishes on a variety of soils, and is one of the earliest grasses to afford pasturage on the prairies. It has a tufted habit of growth and seldom exceeds a foot in height on the dry prairies, but in moist valleys it frequently reaches 2 feet or more and affords an excellent quality of hay. It matures its seed early and then dries up, furnishing but little fresh pasturage afterwards unless well watered. It usually seeds heavily. Stockmen regard it as one of the most valuable native pasture grasses because of its earliness and palatability. To many it is known as wild or prairie timothy, because of its external resemblance to the common cultivated timothy.

One of the most common and valuable "bunch-grasses" on the plains is *Poa buckleyana*. It is most abundant on the high elevated plains and bench lands nearer the mountains, and is usually accompanied by prairie June-grass, blue grama, and some of the wheat-grasses. It is not as early as prairie June-grass, but affords a larger amount of forage and is much better for winter pasturage. It has a very wide distribution in the Rocky Mountain region and is represented by a great variety of forms, some of which, as already mentioned in another connection, are valuable hay producers.

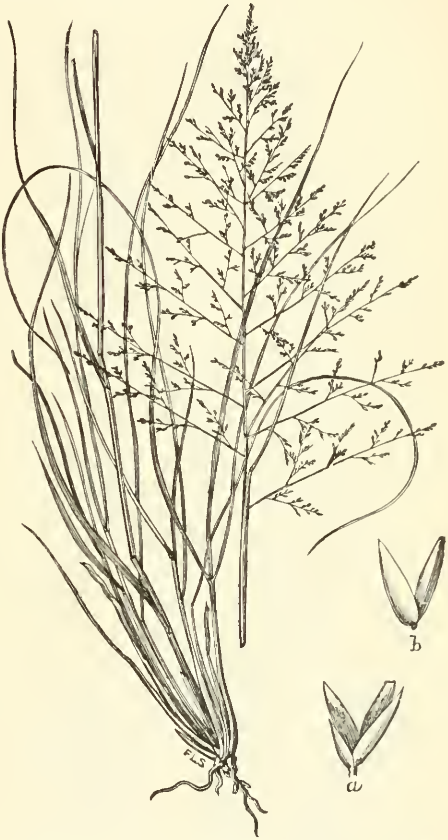

Fig. 21.—Fine-top salt-grass (*Sporobolus airoides*).

In poor sandy soil, or in that containing a large percentage of alkali, the rush-grasses (*Sporobolus* spp.) are important pasture grasses. They are all rather harsh and unpalatable and are valuable chiefly because they thrive in soil that will produce none of the better grasses. When forage is plentiful, stock will not eat them to any great extent, and the plants soon become tough and woody, but during seasons of scarcity these grasses are, like others, kept closely grazed throughout the season and are tenderer and more palatable. During the past season a number of extensive pastures were observed in the Big Horn Basin composed almost exclusively of fine-top rush-grass or salt-grass (*Sporobolus airoides*). (See fig. 21.) These pastures were in alkali bottoms and old lake beds, and were almost the only grass-covered areas of any consequence in that locality. They were grazed by horses principally, and were reported to be improving with continual pasturing. This grass is most abundant in the southern portion of the region, though occurring throughout.

Among other rush-grasses of general occurrence in this region are rough-leafed salt-grass (*Sporobolus asperifolius*), a characteristic "bad-land" grass; sand rush-grass (*S. cryptandrus*), often abundant in sandy prairies and river bottoms; and prairie rush-grass (*S. depauperatus*). There are two forms of the last occurring in this region; one found chiefly in dry soil of prairies and hillsides, too small to be of much value for forage, and the other in moist, more or less alkaline bottom land, tall and slender and producing a greater amount of forage.

Another grass abundant throughout this region in strongly alkaline soils, but of little value except in times of scarcity of forage, is the common salt- or alkali-grass (*Distichlis spicata*). (See fig. 22.) Although often producing a great deal of leafage, it is harsh and unpalatable and is refused by stock as long as other grasses are to be obtained. Sheep eat it more readily than other stock. It is abundant in the bad-land regions, and, as better grasses are usually scarce there, it is sometimes cut for hay. In localities where the land is becoming "alkalied" through improper irrigation, this grass is spreading rapidly and often becomes quite a pest.

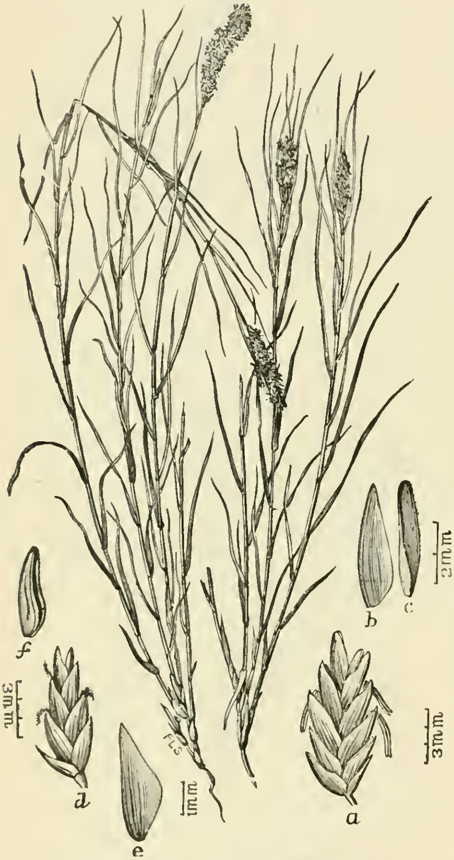

FIG. 22.—Salt-grass (*Distichlis spicata*).

Montana sand-grass (*Calamagrostis montanensis*) is the only representative of this genus that is of much importance as a pasture grass on the dry prairies and foothills. Its distribution is rather local, but where it does occur in any quantity it is a valuable grass. It thrives on sterile, sandy prairies and hillsides and produces a large amount of leaves. It cures well on the ground, and hence affords good winter pasturage. It has not been reported south of the Big Horn Basin, in Wyoming, where it was found the past season in considerable abundance, particularly along the Gray Bull River, on the west side of the basin. It was first observed in quantity at about 5,000 feet altitude, growing on dry, sandy flats and bluffs, continued plentiful up to about 7,000 feet and then gradually became less and less common, disappearing entirely at 8,000 feet.

GRASSES OF THE FOOTHILLS AND MOUNTAINS.

The grasses of the lower foothills differ but little from those of the plains. The sod-forming species become more confined to the valleys and the "bunch" grasses become more and more conspicuous on the bluffs and hillsides. As the higher foothills and mountains are approached, however, changes in the grass flora become apparent. The gramas and wheat-grasses of the plains are replaced by "bunch-grasses" of various kinds, sheep fescue (*Festuca ovina*), and mountain wheat-grass (*Agropyron violaceum*); brome-grasses become more abundant; the common needle-grass, porcupine-grass and feather bunch-grass give way to Tweedy's needle-grass (*Stipa tweedyi*), Nelson's needle-grass (*S. nelsoni*), and purple-top needle-grass (*S. minor*); wild oat-grasses, meadow or spear-grasses, and tussock-grass become plentiful; and mountain blue joint takes the place of common blue joint and yellow-top.

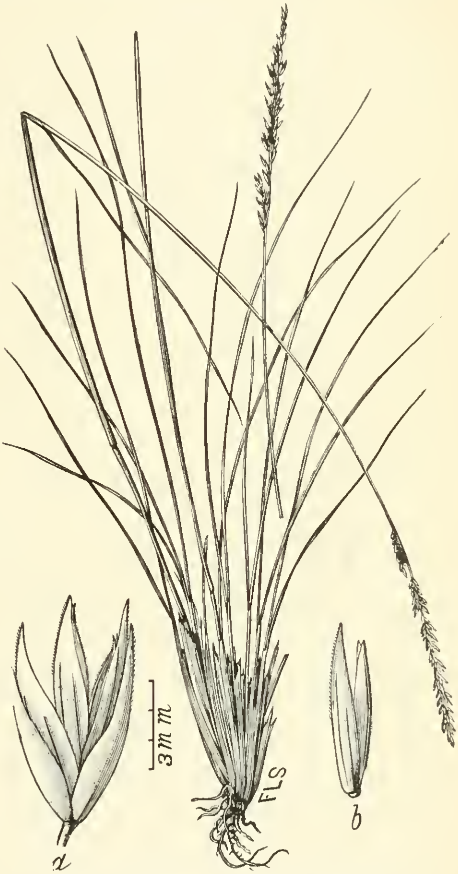

FIG. 23.—King's fescue (*Festuca kingii*).

In the dry soils of the higher foothills and mountains the most important pasture grasses are the "bunch grasses" and the oat-grasses. The former term is a very general one, and as used on the range includes a great many different kinds of grasses. For example, in Colorado "bunch-grass" probably most often means one of the fescues (*Festuca scabrella*), more properly called buffalo bunch-grass; in Wyoming and Montana the term is probably most often applied to the three *Poas* mentioned under the discussion of meadow-grasses, but is also often applied to certain of the fescues, as sheep fescue—often also called "deer grass"—and King's fescue (*Festuca kingii*) (see fig. 23), the northern representative of buffalo bunch-grass. Some of the wheat-grasses (*Agropyron divergens* and *A. vaseyi*) are also "bunch-grasses," but as a rule some modification of the term is used in designating them, as wire bunch-grass or bunch wheat-grass. All the above-mentioned grasses are valuable as forage producers and are widely distributed, most of them occurring over all or at least a large portion of the eastern Rocky Mountain region. In the higher altitudes sheep fescue, the bunch-grass *Poas*, and the wild-oat-grasses furnish most of the pasturage in the dry parks and open places. The mountain form of prairie June-grass (*Koeleria cristata*) is often sufficiently abundant to form a large part of the pasturage in such places.

In the moister soils the pasturage is furnished by the grasses mentioned in the discussion of mountain meadows, supplemented by various additional species of more local occurrence or of less vigorous growth, and hence of less value as forage producers.

Among such additional species might be mentioned downy oat-grass (*Trisetum subspicatum molle*), American oat-grass (*Avena americana*), and a variety of Californian oat-grass (*Danthonia californica unispicata*). The first is an abundant and widely distributed grass, flourishing in a variety of soils, but most commonly found in rather moist open woodlands and edges of thickets. American oat-grass is rather local in distribution, is seldom found below an altitude of 6,000 feet in Montana and Wyoming or about 7,500 in Colorado, and is most abundant in the upper part of the eastern Rocky Mountain region. It usually occurs in rather dry bottoms or on hillsides, and when plentiful affords much good forage. The variety of Californian oat-grass is smaller than the species and is generally found on dry ridges and hillsides, while the species occurs in rather moist meadows. It is quite abundant in portions of Wyoming and western Montana and is regarded as a good pasture grass, to some extent taking the place, in high altitudes, occupied by blue grama on the plains.

NATIVE CLOVERS, VETCHES, AND LUPINES.

The eastern Rocky Mountain region is well supplied with native leguminous plants, many of which are of great value for hay and pasturage. Some are unpalatable and are seldom eaten by stock, and a few are injurious when eaten in any considerable quantity, due to certain poisons or other active principles contained in them. In the three States included in this report there are more than a dozen native clovers, eight or ten native vetches and vetchlings, at least fifty milk-vetches or rattleweeds, two bush-peas, a dozen or more lupines, and a host of other legumes.

THE CLOVERS.

The native clovers are found chiefly in the mountains and at comparatively high altitudes. Some of them are too rare and others too small to be of much value for forage, but the majority are valuable, and four or five are of sufficient importance to warrant careful experimentation as to their possible use as cultivated crops. From their appearance and thriftiness under natural conditions or in irrigated native meadows it would certainly seem probable that several of them would prove of great value for cultivation, especially in the higher altitudes, where alfalfa and the common clovers can not be successfully grown.

Among the most important of these native clovers are Beckwith's clover (*Trifolium beckwithii*), long-stalked clover (*T. longipes*), mountain red clover (*T. megacephalum*), Parry's clover (*T. parryi*), silky dwarf clover (*T. dasyphyllum*), woolly-headed clover (*T. eriocephalum*), and Hayden's clover (*T. haydeni*). Of these, the first three are probably the most valuable. Beckwith's clover has the lowest altitudinal limit. It is abundant in rich meadows in some localities in southwestern Montana at an altitude of about 5,000 feet, and extends as far to the eastward as the Sioux Valley in South Dakota, where it is frequently abundant, though rather local in distribution. It makes a very fine growth in the rich irrigated meadows in Montana, and is regarded as a valuable hay plant. In South Dakota it is found along rather dry swales and creek bottoms and affords a considerable amount of pasturage, and under more favorable conditions becomes large enough to be cut for hay. It seems to endure drought quite well, better than the common red clover, and is well worthy of experimentation. On account of the similarity of the flower heads to those of the common clover, it is sometimes called "wild red clover."

Long-stalked clover is one of the commonest of the clovers native to this region, and has a wide distribution, extending from southern Colorado along the Rocky Mountains to British America and west to the Pacific Slope. It is seldom found below an altitude corresponding to 6,000 feet in southern Colorado. It is at its best near the uppermost limit for alfalfa, and is often found in quantity up to 9,000 feet altitude. It is a slender, narrow-leafed plant, usually a foot or more in height, with pale, cream-colored or purplish flowers. It is highly prized as a forage plant by stockmen, by whom the pale-flowered variety is sometimes called "wild white clover." It makes a fine growth in irrigated meadows and deserves to be given a trial under cultivation.

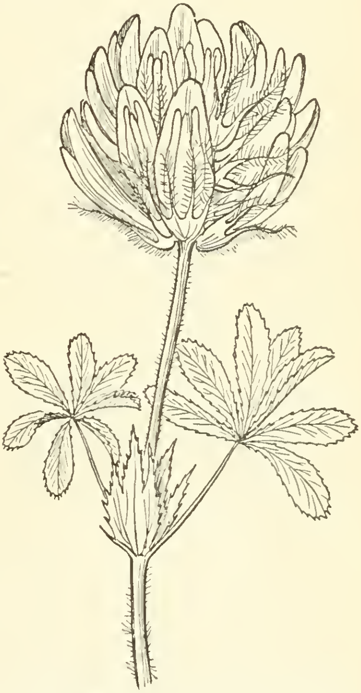
FIG. 24.—Mountain red clover (*Trifolium megacephalum*).

Woolly-headed clover has much the appearance of long-stalked clover, and occurs in similar situations, but seems to have a more limited distribution, and is chiefly confined to the region west of the Continental Divide.

Mountain red clover (see fig. 24) is one of the most robust-growing native sorts found in the Rocky Mountain region. The flower heads are large and showy, and the leaves are composed of from five to seven leaflets, instead of three, as is the case with the other clovers of the region. It produces stout, deep-growing roots, and has many other qualities commending it to the attention of the experimenter. Like the preceding, it is most widely distributed on the west side of the Continental Divide.

The other clovers mentioned in the preceding list are all rather small and are of especial value only as pasturage. The most important are: Parry's clover, generally distributed in the central Rocky Mountain region, and most abundant at an altitude of from 10,000 to 13,000 feet; silky dwarf clover, likewise occurring in the central Rocky Mountain region, but with lower altitudinal limits and growing on drier soil than Parry's clover; and Hayden's clover, occurring in moist soil from Wyoming north along the mountains at an altitude of from 7,000 to 10,200 feet.

All the clovers mentioned in the preceding pages are perennials. There are only two or three species of the annual clovers native to the region. Annual red clover (*Trifolium involucratum*) is widely distributed and is by far the most valuable of the annual sorts. Few-flowered clover (*T. pauciflorum*) is occasionally met with, and it is likely that small-headed clover (*T. microcephalum*) may occur in western Colorado and southwestern Wyoming. The annual clovers are all found at comparatively low altitudes.

THE VETCHES AND VETCHLINGS.

Two species of the true vetches occur in this region and both are of value for forage. American vetch (*Vicia americana*) is found in rich, moist meadows and open thickets, and is regarded as a valuable native forage plant. It produces long trailing or climbing vines quite thickly covered with leaves and affords a good yield of forage. Narrow-leafed vetch (*V. linearis*) is much smaller than the preceding, occurs in drier situations, and, like it, is distributed throughout the entire region. It affords less forage than American vetch, and is less palatable, but thrives on soil too dry for that species, and hence replaces it in many localities. It is a hardy, aggressive plant, and rapidly takes possession of idle, broken land, under some circumstances becoming a weed, although not a troublesome one.

The vetchlings are better represented in this region than the true vetches, some five or six kinds being found, of which at least three are of value for forage. They are not very palatable in the fresh state, and hence are of more importance as hay plants. The most valuable sorts are the prairie vetchlings (*Lathyrus ornatus* and *L. polymorphus*) and marsh vetchling (*L. palustris*). The former are found chiefly in the central and southern portions of the region, while the latter occurs throughout.

Small prairie vetchling (*L. ornatus*) is usually found in dry prairies, and in some parts of the region, as in southeastern Wyoming, is very abundant. It fruits plentifully, and the seeds are said to be edible, comparing favorably with the common garden pea. The larger prairie vetchling (*L. polymorphus*) occurs in rather moister situations than the preceding and is a somewhat more robust plant with much larger flowers. It is very abundant in portions of central and southern Colorado, where it is regarded as a valuable element in native meadows.

Marsh vetchling is a much taller plant than either of the foregoing and occurs chiefly in rich, moist meadows and about the edges of thickets. It is frequently sufficiently abundant to form an important part of the hay, adding very materially to its feeding value. In some localities it is called "meadow pea."

Among other vetchlings occurring in this region of more or less value as forage plants are veiny-leafed vetchling (*Lathyrus venosus*), growing usually on sparsely wooded hillsides and river banks, and cream-colored vetchling (*L. ochroleucus*), found in similar situations to the preceding.

One of the most valuable leguminous plants found on the prairies is Dakota vetch (*Lotus americanus*) (see fig. 25), a bushy annual growing throughout the entire Rocky Mountain region. It is most abundant on sandy river bottoms, but also occurs on the drier uplands. Stock is very fond of it, either as pasturage or as hay. In the Upper Missouri region it is one of the most highly prized native forage plants, and the rancher who has a good lot of it in his meadows and pastures considers himself fortunate. As it is an annual it must be allowed to mature its seed and should not be grazed too closely nor cut too early. The blooming season is quite long, so that buds, flowers, and both green and mature fruits may often be seen on the plant at the same time. As a rule many of the seeds are ripened before haying time arrives, and it is a common practice among ranchers to use hay racks with tight bottoms in order to save the shattered seed that it may be scattered over thin places in the meadows.

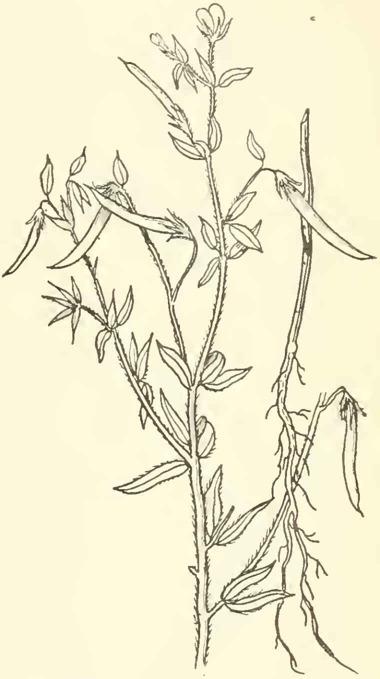

Fig. 25.—Dakota vetch (*Lotus americanus*).

THE LUPINES.

Although the wild lupines are so abundantly represented in this region, as to both kinds and individuals, they can hardly be regarded as of much value for forage from the fact that they are generally so unpalatable that stock will seldom eat them unless forced to do so by hunger. Sheep eat them more readily than other stock. Many of the species thrive on dry, rocky soils too poor to produce much other vegetation, and they probably do a great deal toward improving the fertility of these soils, and are thus indirectly beneficial; but many ranchers regard them as weeds, owing to their tendency to spread rapidly in overstocked pasture lands.

THE MILK-VETCHES.

The milk-vetches, or rattle-weeds, as some of them are called, are by far the best represented group of leguminous plants in the range region. Of the numerous sorts some are valuable forage plants, others are too small to be of any value or are so unpalatable that stock will not eat them, and a few—the so-called "loco weeds"—are injurious to stock under certain circumstances, causing considerable loss by killing the animals eating them.

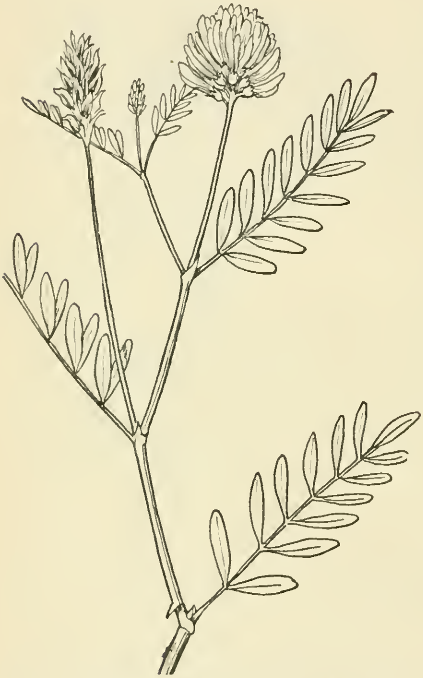

FIG. 26.—Prairie milk-vetch (*Astragalus adsurgens*).

The milk-vetches occur on a great variety of soil, from rich, moist bottom lands to dry, sterile, rocky, and gravelly ridges, often forming a large proportion of the vegetation. In some of the species the fruits are large and fleshy and are much sought after by stock, particularly by sheep. There are probably a great many kinds that are of more or less value as forage plants, but our knowledge of the real value of most of the species is very limited and reports are contradictory, some stockmen regarding certain sorts as injurious, while others maintain that they are valuable forage plants, stock eating them with the best of results.

Among the most common and valuable kinds are bristly-fruited milk-vetch (*Astragalus hypoglottis*), ground plum or buffalo pea (*A. crassicarpus*), larger ground plum (*A. mexicanus*), and prairie milk-vetch (*A. adsurgens*), (see fig. 26.) Other species, regarded by many as valuable, are Morton's milk-vetch (*A. mortoni*), zigzag milk-vetch (*A. flexuosus*), and slender milk-vetch (*A. gracilis*). Low milk-vetch (*A. lotiflorus*) and bitter milk-vetch (*A. bisulcatus*) are by some regarded as good forage plants and by others as injurious species. Some years ago the writer observed both cattle and horses eating considerable quantities of the former without any apparent ill effect, but the latter is so bitter and strong-scented that it would hardly seem possible that stock would eat much of it.

RUSHES AND SEDGES.

These grass-like plants play no small part in the forage supply and are of much more importance than is generally understood. There are almost as many kinds of rushes and sedges native to this region as there are grasses, and all are eaten by stock to a greater or less extent. Comparatively few kinds grow on the dry prairies and hills, most of them occurring in low prairies, meadows, and bogs. Sometimes the greater part of the hay obtained from wet, boggy meadows is made up of these plants. They are particularly abundant in some of the mountain meadows, frequently, especially early in the season, occupying the land almost to the exclusion of the grasses.

RUSHES.

There are at least six of the bulrushes that deserve mention as forage plants. These are meadow bulrush (*Scirpus atrovirens*), salt-marsh bulrush (*S. robustus*), river bulrush (*S. fluviatilis*), small-fruited bulrush (*S. microcarpus*), prairie bulrush (*S. campestris*), and alkali or chair-makers' bulrush (*S. americanus*). The best of these, though not necessarily the most abundant, are river bulrush, meadow bulrush, and salt-marsh bulrush. Alkali or chair-makers' bulrush (the former name is most used in this region) is one of the most abundant species, and, as its common name indicates, occurs on alkali flats along streams and elsewhere in moist soil containing large quantities of alkali. It is tough and wiry, but is often eaten by stock when better forage is scant.

Of the spike-rushes, common spike-rush (*Eleocharis palustris*) and flat-stemmed spike-rush (*E. acuminata*) are the most important. In wet meadows, particularly those that are overirrigated, these rushes are very abundant, sometimes forming the larger part of the vegetation. Some of the larger forms of common spike-rush yield a large amount of hay, but the quality is much inferior to that obtained from the grasses.

There are a dozen or more of the bog rushes found in the eastern Rocky Mountain region. All are tough and wiry and afford an inferior quality of forage, but a number of them are sufficiently abundant to form a large part of the vegetation in some of the native meadows. The species most frequently found are slender bog rush (*Juncus tenuis*), Torrey's bog rush (*J. torreyi*), Baltic bog rush (*J. balticus*), knotted bog rush (*J. nodosus*), Nevada bog rush (*J. nevadensis*), and mountain bog rush (*J. xiphioides montanus*).

SEDGES.

The list of sedges is a long one, more than a hundred different kinds being found in the Rocky Mountain region. They furnish a better quality of forage, as a rule, than that obtained from the rushes. Some of the species grow on dry prairies and hillsides, but the majority prefer the moister soils of the valleys and lowlands. Sedges form a conspicuous part of the vegetation of the meadows and moist mountain sides at the higher altitudes. Some of the species are small and are of value only as pasturage, but many others are of sufficient size to yield a large amount of hay which compares favorably in quality with that obtained from grasses growing in similar situations.

On the dry uplands, thread-leafed sedge (*Carex filifolia*), often also called "wire-grass," and dwarf sedge (*C. stenophylla*) furnish pasturage, the former being very abundant on dry ridges in some localities and highly prized by stockmen. Dwarf sedge is often plentiful in dry meadows, where it is larger than on the uplands. In swales and dry meadows silvery-top sedge (*C. siccata*), clustered field-sedge (*C. marcida*), and Douglas sedge (*C. douglasii*) are of considerable value for both hay and pasturage. There are a great many different forms of the Douglas sedge, some of them large and affording a good yield of hay, and others too small for anything but pasturage. The species is one of the most abundant in the sections nearer the mountains and also ascends to the higher altitudes. Brown-top sedge (*C. festiva*) is also abundant and valuable, but usually occurs in moister situations than the last. In wet, boggy meadows the sedges sometimes compose more of the vegetation than do the grasses. This is particularly the case at the higher altitudes or above 7,000 or 8,000 feet. The species most commonly found in these meadows are tussock sedge (*C. stricta*), bottle sedge (*C. utriculata*, and var. *minor*), Nebraska sedge (*C. nebraskensis*), woolly-fruited sedge (*C. lanuginosa*), and giant sedge (*C. aristata*). All produce a relatively large amount of leafage, and when cut in proper season afford hay of average quality.

MISCELLANEOUS NATIVE FORAGE PLANTS.

There are many miscellaneous plants native to this region that help to make up the general forage supply. These are mostly plants that the uninformed individual would regard as weeds, but which, under the conditions prevailing on the range, form an important part of the annual supply of stock feed. On the plains and foothills this vegetation consists very largely of the various kinds of "sage" and saltworts, plants characteristic of the arid and semiarid West. In the mountains it consists mainly of shrubby willows, mountain mahogany, shrubby cinquefoil, and purshia. There is a great variety of plants called "sage" on the range, as, for example, the bitter sages, or "sage-brush" (*Artemisia* spp.); green sages, or "rabbit-brush" (*Bigeloria* spp.); salt-sage (*Atriplex* spp.); sweet sage, or winterfat (*Eurotia lanata*), etc.

THE BITTER SAGES.

The bitter sages, or sage-brushes, are most of them so bitter that stock will not eat them as a general thing, except in times of scarcity of forage. Sheep eat the sage-brush more often than do any other of the domestic animals. They do not make a general diet of it, but eat small quantities now and then, as if for a tonic or appetizer. Bud brush or spring sage (*Artemisia spinescens*) is probably the most valuable of this group of sages. It is most abundant in the Red Desert of Wyoming, and extends into the arid regions to the southwest. The masses of young leaves and flowers are much relished by sheep, and the plant is regarded as an important member of the forage-producing species of the desert. Silvery sage (*A. cana*) is probably the next most valuable of the bitter sages. When browsed closely it produces a great many annual shoots, which are quite succulent and are eaten by sheep to a considerable extent.

THE SALT-SAGES.

The salt-sages are of much more importance as forage plants than the bitter sages. There are more than a dozen species native to this region, and all are of value for forage. In some sections, as in central Wyoming and in the Red Desert, these salt-sages, or "salt-bushes," furnish more of the forage than all the other plants combined. The kinds of most importance in this region are Nuttall's salt-sage (*Atriplex nuttallii*), spiny salt-sage (*A. confertifolia*), hoary salt-sage, or shad scale (*A. canescens*) (see fig. 27), Nelson's salt-sage (*A. pabularis*), silvery salt-sage (*A. argentea*), tumbling salt-sage (*A. volutans*), and spreading salt-sage (*A. expansa*). All are annuals except the first three, which are perennials and are of especial importance for winter pasturage. The leaves, fruits, and young shoots are relished by all kinds of stock. Of the three, Nuttall's salt-sage is probably the most valuable.

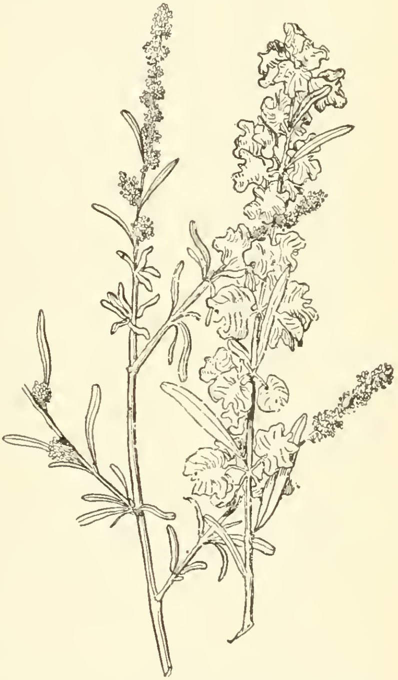

FIG. 27.—Shad scale (*Atriplex canescens*).

The salt-sages thrive on land strongly impregnated with alkali, and so dry that but little other vegetation will exist upon it, and as there are many thousands of acres of such land in this region these plants are of particular importance. In certain districts, as along the Green River in Wyoming and also in the central part of the State, there are extensive areas in which the water supply is so limited that stock can not be kept on them during the summer. Here it is that the salt-sages thrive, and are of especial value for winter forage. During the growing season the plants make a good development, as they are not kept back by grazing, and the ripened fruits and "sun-cured" leaves, together with the young shoots, make excellent forage for winter, when, since the snow furnishes the animals with water, the stock can be brought to these regions. Thus it is that these desert areas become valuable winter pastures and furnish food for many thousands of sheep, cattle, and horses for about four months of the year. Stockmen, especially those owning large droves of sheep, are almost as anxious to establish and maintain their rights to "winter ranges" on these desert areas as they are to secure their "share" of the summer range on the prairies and in the mountains.

Under this system of winter grazing the condition of these salt-sage pasture lands is continually improving. This is probably due to the enriching of the land from the droppings of the animals, and to the increased production of new shoots by the perennial sages, resulting from the close browsing by the animals during winter, followed by an undisturbed period of growth in the summer.

The annual salt-sages are valuable principally for summer and autumn forage, not usually being persistent enough to be of much importance for winter use. However, under certain circumstances, the fallen leaves and fruits may be collected by the wind into little piles in depressions of the ground, or behind shrubs and other persistent plants, and are picked up by sheep or other stock. Under ordinary conditions all of the salt-sages mentioned in the above list produce an abundance of seed, and in most cases it is easily gathered. In view of the recognized value of these plants for forage it would seem well worth while to attempt to grow the better sorts under cultivation. There are many localities where they could be used to advantage.

WINTERFAT.

One of the most highly prized of the sages is winterfat or sweet sage (*Eurotia lanata*). (See fig. 28.) It is a rather small, woolly, half-shrubby perennial, found throughout the Rocky Mountain region in the dry soil of the plains and foothills. It is of most importance for winter pasturage and is esteemed not only for its feeding value, but also for a beneficial effect which it is supposed to have on the health of stock eating it. It usually fruits abundantly, and the great fattening qualities attributed to it are no doubt largely due to the fact that the matured fruits compose a large part of the forage obtained by the animals.

Winterfat grows readily from the seed and could undoubtedly be cultivated to good advantage in many localities.

GREASEWOOD.

Another plant of great value for forage on dry, sterile, strongly alkaline soil is greasewood (*Sarcobatus vermiculatus*). (See figs. 3 and 29.) It is more or less abundant throughout the entire region and is of especial importance in the bad lands and in sterile, broken areas on bluffs along the streams, and on the so called "black alkali" spots in the valleys and plains. It is a scraggy, thorny shrub from 2 to 10 feet high, with fleshy, succulent leaves, and usually produces an abundance of fruit. The leaves, fruit, and young shoots are eaten by stock to such an extent that in some localities the plants are kept so closely browsed as to be ultimately destroyed. Under ordinary conditions this plant furnishes a large amount of forage and is particularly valuable, since it will thrive on soil that will not even produce sage-brush. As stated elsewhere in this report, "sage-brush" land is easily subdued, and under irrigation produces excellent crops of grain, alfalfa, etc., while "greasewood" land is regarded as of but little agricultural value by ranchers because of the quantity and character of the alkali contained in it.

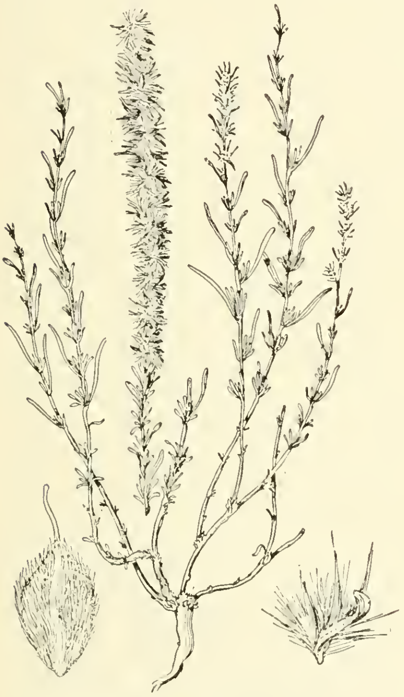

FIG. 28.—Winterfat (*Eurotia lanata*).

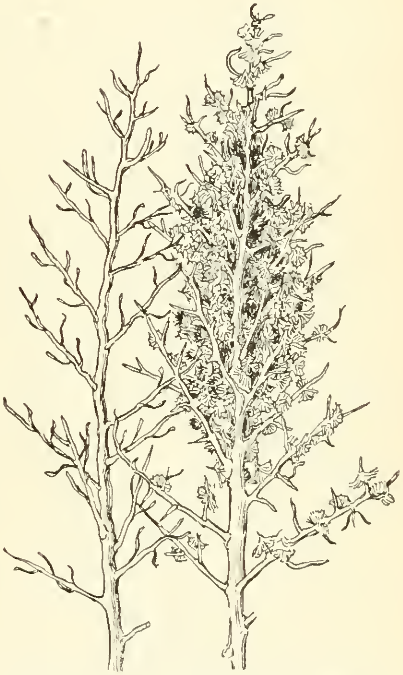

FIG. 29.—Greasewood (*Sarcobatus vermiculatus*).

MISCELLANEOUS.

Among other plants of weedy habit which add considerably to the forage supply in some localities are the goosefoots or lambs-quarters

(*Chenopodium* spp.) and the knotweeds (*Polygonum* spp.). There are a half-dozen species of each that occur in sufficient abundance to be of value. They are usually found in broken soil along banks and trails and about desiccated ponds, occupying land in which grasses will not thrive or from which they have been killed out.

In the higher foothills and mountains the browsing is principally furnished by such shrubby plants as the willows, shrubby cinque-foil (*Potentilla fruticosa*), mountain mahogany (*Cercocarpus parvifolius*), Torrey's nine-bark (*Physocarpus torreyi*). and Purshia (*Purshia tridentata*). These are all often so extensively eaten by stock that it is difficult to find a plant showing anything like its natural habit of growth. This is particularly true on the sheep ranges. Shrubby cinque-foil was seen in great abundance the past season (1897) on the Big Horn Mountains, but wherever the sheep had been ranged to any considerable extent the bushes were so closely browsed that it was difficult to get good botanical specimens. The same was true to a great extent with the several species of shrubby willows occurring on the same mountains.

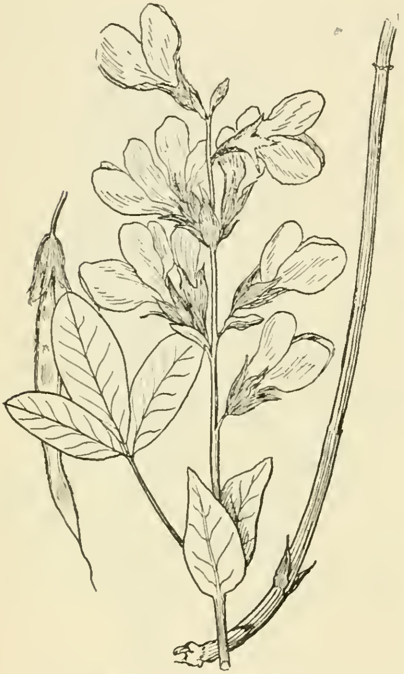

Fig. 30.—Montana bush-pea (*Thermopsis montana*).

Wild liquorice (*Glycyrrhiza lepidota*) is abundant in low, sandy prairies and river bottoms throughout the range region. This plant, regarded as a troublesome weed in the eastern prairie States, is highly esteemed as a forage plant by many ranchers. It is often present in abundance in the hay obtained from river-bottom meadows, and such hay is regarded as having high feeding value. In the Big Horn Basin it is frequently called "wild alfalfa," and many tons of it are cut annually.

In addition to the various plants mentioned in the preceding pages, all of recognized value as forage producers, there is a long list of plants which, although each is perhaps of but little value in itself, when they are considered in the aggregate the amount of forage afforded by them is large. Such are the prairie clovers (*Petalostemon* spp. and *Psoralea* spp.), the Daleas (*Dalea alopecuroides* and *D. aurea*), the bush-peas (*Thermopsis montana* (see fig. 30) and *T. rhomboidea*), the herbaceous cinque-foils (*Potentilla* spp.), wild asters, and many others.

IMPROVEMENT OF THE RANGES.

One of the most important factors in the improvement of the range conditions would be the establishment of some system of control which would allow each rancher the exclusive right to graze his stock on a given piece of land for a long term of years. As long as the "open range" is "free to all," ranchmen will continue to try to get their "share" of it and there will be no possibility of any substantial improvement. Under the present conditions there is no incentive for the rancher to make any special efforts to improve the range except in so far as it has to do with the immediate necessities of his stock. He knows that if his stock does not eat the grass, that of somebody else will, and naturally he thinks he might as well benefit by it as anyone. In his efforts to get his "share" he contributes to the general destruction instead of trying to avert it.

It is argued that if the rancher could secure a long lease to a portion of these public lands it would then be to his interest to improve and maintain their productivity. He could then afford to build fences and adopt other measures for the betterment of his holdings, being sure that he and not someone else would get the benefit of his endeavors.

With the recent rapid increase in the number of tilled ranches and the growing tendency toward the raising of more coarse forage for winter feeding, it ought to be possible to handle more stock than formerly instead of less, as is the case at the present time. Thus in the Big Horn Basin and elsewhere in northern Wyoming ranchers assert that they can easily raise winter feed for more stock than their summer range will carry in its present depleted condition. This statement is borne out by the fact that on many ranches one may see large quantities of surplus hay, often representing portions of crops of two or three years. There are other districts in which the practice of growing forage for winter use should be greatly extended. The range could supply plenty of pasturage for a part of the year, but is insufficient for both summer and winter forage. Millet, rye, oats, field peas, rape, sorghum, and other forage crops can some of them be grown with at least a fair degree of success in most localities in this region, and an extension of their cultivation would have a beneficial effect on the open range, in that it would be less closely grazed.

An important problem to be considered in connection with the improvement of range conditions is that of the water supply, particularly as to the conservation and more equable distribution of the annual rainfall. Something can be done by the individual efforts of the stockmen, but if much permanent good is to be accomplished the united efforts of the community and possibly the aid of the local or the General Government will need to be turned in this direction.

The conservation of water in this manner would serve a twofold purpose. Not only would it render possible the irrigation of more land adapted to the growing of forage and other crops and the better irrigation of land already under cultivation, but water would also be provided for stock in places convenient to the grazing lands, and much of the injury to the range due to excessive trampling would be avoided. As the laws governing the distribution of water for irrigation become better understood and more justly applied much of the present unequal distribution of the water from the running streams will be corrected, and stock will be better supplied with drinking water and more forage will be produced. Under the present conditions one may frequently see a man injuring his meadows and fields by using too much water, while those of his neighbor some miles down the valley are suffering, perhaps totally ruined, for lack of water.

In a region varying so widely in soil and climatic conditions it is not to be expected that any one or two grasses or forage plants can be introduced to meet all the requirements. Timothy, redtop, alfalfa, and other of the commoner "tame" sorts have shown themselves admirably adapted for certain localities. Smooth brome is being used with fine success in some of the drier sections. But other varieties are needed, and the only way to select them is through careful experimentation. It is not necessary that these experiments should be elaborate. Each rancher should test one or two of the hardy grasses or forage plants in a small way each season, and thus determine for himself what kinds are best adapted to his needs and to the conditions prevailing in his locality.

These experiments should not be confined to "tame" or introduced sorts, but should be extended to desirable native kinds, such as have been mentioned in the preceding pages. There is no locality without native grasses or forage plants that are worthy of trial under cultivation, and anyone can, with but little trouble, obtain enough seed for such a test. Some farmers are already following this plan, and while some attempts meet with failure, others give very encouraging results—so much so that the great value of some of the native species is clearly demonstrated for certain localities, and in some cases the seed is being placed on the market, as for example, slender wheat-grass (*Agropyron tenerum*) and reed canary-grass (*Phalaris arundinacea*). It is extremely likely that there are native varieties of grasses and clovers which will be found to be well adapted for cultivation above the altitudinal limits of timothy, alfalfa, and other of the commonly cultivated grass and forage crops. Among such may be mentioned Nevada blue grass (*Poa nevadensis*), Wyoming blue grass (*P. wheeleri*), rough-leafed bent (*Agrostis asperifolia*), mountain foxtail (*Alopecurus occidentalis*), short-awned brome (*Bromus breviaristatus*), western brome (*B. pumpellianus*), Beckwith's clover (*Trifolium beckwithii*), and long stalked clover (*T. longipes*).

As a general rule ranchmen assert that the only treatment required for the restoration of the range is rest, but this under the present conditions is practically an impossibility. Moreover, in some localities the work of destruction has gone so far that something more than mere rest is necessary. The valuable grasses have been killed out and their places taken by plants of weedy habit, of little, if any, value for forage, or the land is without vegetation at all. To reclaim such areas artificial seeding is necessary. With these places again seeded and producing forage it will be easier to give at least a partial rest to the lands on which there still remains enough of the good grasses to accomplish natural reseeding. Many farmers and ranchmen in the Northwest have been able to materially increase the stock-carrying capacity of their pasture lands by scattering over the worn spots the seed of such grasses as western wheat-grass (*Agropyron spicatum*), prairie June-grass (*Koeleria cristata*), Kentucky blue grass, and smooth brome. Sometimes these areas are harrowed or "disked" after seeding, and sometimes not. One practice is to seed while the ground is wet and drive stock over the land to work the seed into the soil.

When wheat-grass is already present in considerable quantity the productiveness may be vastly improved by "disking" up the land. Some farmers even go so far as to plow up the land and then allow the wheat-grass to come in again, which it does in a very short time. This latter method keeps the land in better condition and gets rid of weeds, and is a good practice to follow on the smaller ranches. When seed can be had it would be a good plan to sow a small quantity of prairie June-grass, bench-land spear-grass, smooth brome, or other of the better native or introduced sorts, that the land may be occupied at once. Sometimes such annuals as millet, oats, rye, and sorghum can be used to advantage. The practice of fencing the range in such a manner that one portion of it may be grazed while the other is resting is to be recommended. This allows the grasses opportunity to recuperate and to produce seed occasionally.

If each ranchman and farmer could but keep the land under his own immediate control up to the point of greatest productivity the indirect effect upon the open range through decreased demands upon it would be decidedly beneficial. In the absence of some rational system of control for the open range little can be done in a direct way to bring about better forage conditions upon it, but much can and will be done on private holdings as soon as the ranchers realize, as they are beginning to do, that they can not be continually taking from their meadow and pasture lands without adding something to them by care, occasional reseeding, and cultivation.

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BULLETIN No. 13. Agros. 33.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF AGROSTOLOGY.
[Grass and Forage Plant Investigations.]

THE RED DESERT OF WYOMING

AND

ITS FORAGE RESOURCES.

BY

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PREPARED UNDER THE DIRECTION OF THE AGROSTOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., June 29, 1898.

Sir: I have the honor to transmit herewith and recommend for publication as Bulletin No. 13 of this Division a report by Prof. Aven Nelson on The Red Desert of Wyoming and its Forage Resources, prepared in accordance with the instructions of the Agrostologist. The Red Desert region of Wyoming is a waterless and nearly treeless area. During the summer season it is practically uninhabitable, and a visitor at this time would doubt very much whether the region could be utilized in any way, especially as a stock range, but as a matter of fact this Red Desert actually affords excellent winter pasturage. Here are fed the herds and flocks of adjacent summer ranges, and many of the stockmen in northwestern Colorado, eastern Utah, and southern Idaho find in this region a desirable place to winter their stock, especially their sheep. So far as I am aware, we have in this report the first presentation of the value of the Red Desert and other similar regions which occur in the interior of all large continents as ranges for stock, and the account given of the various forage plants upon which thousands of cattle and sheep graze during the winter months can not fail to be of interest. Among these plants which afford nutritious food and apparently thrive in the driest climates and in strongly alkaline soil there are doubtless varieties that are well deserving of propagation, and by their cultivation land now totally waste may be rendered valuable.

Respectfully,
F. Lamson-Scribner,
Agrostologist.

Hon. James Wilson,
Secretary of Agriculture.

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THE RED DESERT OF WYOMING AND ITS FORAGE RESOURCES.

INTRODUCTION.

The region known as the Red Desert lies in southern Wyoming. Our knowledge of the plants of this region has heretofore been very imperfect, due chiefly to the difficulty and hardships involved in conducting investigations during the summer months. As the Union Pacific Railroad traverses the entire region from east to west, information concerning its vegetation has, of course, been accumulating, but previous to the present season (1897) no systematic survey of its resources has ever been attempted.

There is little in view from the car windows to invite closer inspection or more personal contact. From the Platte River to the Green River, a distance of 150 miles, there is not within sight of the railroad any vegetation larger than sage-brush and grease-wood, and through much of the distance these also seem dwarfed and scattering. Bright green hues are extremely rare. With the exception of the fringes on the banks of the few little creeks and the occasional bogs, the vegetation is marked by colors which blend closely with those of the ground, the dull grayish greens and grays varying to silvery white. To this absence of bright coloring in vegetation, is largely due the singularly barren appearance of the whole region, and no doubt its reputed desert-like condition is traceable to the same cause. Portions of the region are deserted during a part of the year, but it is far from being a desert if by that term is meant "bare of vegetation." This is attested by the fact that great herds of cattle and flocks of sheep are profitably wintered there year after year.

The conditions surrounding the Red Desert made it evident that the region was an interesting field for investigation either from an economic or a botanical standpoint. In order to gain an adequate idea of its vegetation, it was deemed necessary to make at least three incursions into the heart of the region for the spring, summer, and autumn floras, respectively. In pursuance of this plan, the first trip was made under the direction and in the interest of the experiment station of the University of Wyoming. The two later expeditions were made under a commission from the Secretary of Agriculture through the chief of the Division of Agrostology.

In this report account is taken of the field observations and material obtained during the three trips into the region. The material secured during the first trip was miscellaneous in its character, all plants then in condition for collection being included. On the later trips only such plants as were of known or possible forage value were collected.

ITINERARY.

In order to gain an adequate idea of the flora of the desert as related to the stock interests of the State one must know something of the summer pasture as well as the winter range. On this account the field work was extended into the hills and mountains of the southern border of the State, both east and west from the desert.

To examine in detail all this vast region in one season is evidently an impossibility, nor is it probable that such a comprehensive survey would prove profitable, for within the desert can be found certain distinctive areas, a knowledge of which will give a fair idea of the whole.

On account of the limited time at command for the first trip (ten days in the latter part of May and early June), observations and collections had to be confined to areas adjacent to the railroad stations. Though the trip was extended as far west as Evanston, most of the time was spent within the Red Desert proper, at Green River, Point of Rocks. Bitter Creek, Red Desert Station, Wamsutter, and Fort Steele.

While working under the commission above referred to, places in the desert were explored more or less thoroughly during July and again during the latter part of August and early September. Creston, Wamsutter, Bitter Creek, Point of Rocks, Rock Springs, and Green River served as bases from which contiguous territory was investigated, and together they gave a representative series of the forage plants on an east and west line. To obtain an equally representative series on a north and south line two expeditions were made. The northern part of the desert was investigated by a journey from Point of Rocks to South Butte, Fifteen Mile Springs, and Black Rock Butte. As at each of these places there are springs, while the intervening country is typical of the plains portion, these collections are fairly representative of the northern portion of the region.

To similarly investigate the southern half of the desert, a journey was made from Rock Springs by way of Cooper's ranch to Rife's ranch on North Vermilion Creek, the location of a former post-office called Vermilion. This is about 55 miles from Rock Springs, and between the two places there is no usable water except at the Cooper ranch, which serves as the "half-way place" in making the journey. Mr. Rife's ranch is located just on the border of the desert in the foothills of Pine Mountain, on either side of which stand the low, wooded, Bishop and Diamond mountains.

While making the ranch headquarters a few days were spent investigating the forage plants of the adjacent hills and mountains, extending the observations south to the Colorado-Wyoming line. Here was found the region of the ideal summer pasture, an area which those who depend upon the desert for winter forage utilize for summer range.

The return to Rock Springs was made by another route, the midway watering place being at "The Gap," a pass through a range of hills. This journey, both going and returning, was made so leisurely as to afford ample opportunity for collecting and observation. This glimpse of the rich summer range to the southwest of the desert made it desirable that more should be known of the forage which fattens for the autumn markets so much of the stock whose winter range is in the desert. Accordingly, observations and collections, both east and west, were made. For points west, Evanston and Granger were selected, and were visited in late July and again in late August and early September. For points east, some localities in the Medicine Bow Mountains of Albany County and in the Sierra Madre Mountains of Carbon County, were chosen for investigation. Outfitting for this latter work at Laramie, the first three weeks of August were devoted to the investigation, resulting in large and interesting collections.

A knowledge of the forage of the summer range adjacent to the Red Desert is interesting and valuable from the fact that the floras of the two areas are complementary to each other, each rendering the other available by giving range forage throughout the year to the stock of the region. Because of climatic and vegetal conditions one is unsuitable during that part of the year when the other is at its best.

LOCATION AND EXTENT OF THE RED DESERT.

The area originally designated by the name Red Desert is but a small part of what is now considered as within its boundaries (see Pl. I, fig. 1). The name was first applied to a tract, possibly less than 15 by 20 miles in extent, characterized by the peculiar red clay soil of the Wasatch Eocene formation. Near the center of this limited but really *red* desert area we find the side track and section house on the Union Pacific bearing the designation "Red Desert."

The larger Red Desert as now understood includes, however, all that arid section of salt-impregnated soil in southern Wyoming, in which the salt-sages predominate, and which, on account of the absence of suitable stock water, can only be used for winter pasture. The stock owner who speaks of his stock "feeding" (not "grazing") in the Red Desert uses the name of the region in this comprehensive sense.

This region includes, when bounded in this way, a well-marked plant formation or area. It may be said to extend from the Platte bluffs on the east to the Green River bluffs on the west; from the northern limit of Sweetwater County to the hills and mountains separating Colorado and Wyoming on the south. Geographically, then, it is situated between latitudes 41° and 42° 20′ north and longitudes 107° to 109° 30′ west. Excluding from this rectangle the southwest corner, which is fairly well watered, there still remains a tract approximately 85 by 130 miles in extent, embracing more than 11,000 square miles, an area much larger than the State of Massachusetts. This vast area is included in that part of Sweetwater County east of Green River and certain portions of Carbon County west from the Platte.

TOPOGRAPHY.

The Red Desert is a high, undulating plain or plateau, crossed and intersected at intervals by low ranges of hills (Pl. I, fig. 2). Occasional buttes occur, standing sentinel over the groups of hills that rim in the shallow basins or form the zigzag bluffs of the many dry draws or the infrequent creeks.

Far toward the northern boundary one sees the large, isolated butte known as Steamboat Mountain, and beyond this, on the horizon's rim, Antelope Hills, Green Mountains, and Ferris Mountains. This series, extending from east to west, forms the watershed on the south side of Sweetwater River and the northern boundary of the desert. To the north of the railroad are the Leucite Hills. Black Rock Butte and Orendo Butte are well-known landmarks. Toward the east, as viewed from the heart of the desert, no relief appears, unless, perchance, a little toward the north one sees the tops of the Seminole Mountains. The southern boundary is made by ranges of hills and occasional wooded mountains, the view of which, however, is intercepted by the high bluffs that border the narrow valleys. On the western border, in the Green River bluffs, there is scenery of no mean type. Here buttes, long famed, overlook a valley that has had a reputation for grandeur and picturesqueness for more than half a century.

Crossing the desert from north to south, east of the center, is the height of land—the watershed of the continent. Here are parted the waters of the Platte and the Green, flowing, respectively, toward the Atlantic and Pacific. The railroad intersects this line near Creston, the exact point being marked by a signboard announcing this fact.

From an altitude of 7,038 feet at Creston, the land slopes away gradually toward the east and toward the west, but probably the average altitude for the whole region, if one takes into account the increased altitudes both in the northern and southern portions, is not far from 7,000 feet. The lowest altitudes are found in the narrow, bluff-bordered valley of Bitter Creek, which (Pl. II, fig. 1), with an elevation of 6,700 feet at Bitter Creek Station, drops to 6,077 feet at its junction with Green River near the town of that name.

GEOLOGY.[1]

The geology of the Red Desert is so varied that it is almost impossible to give a suitable brief description. Considering that the desert extends from the Rawlins uplift west to the Green River, and from the Colorado line north to the bluffs south of the Sweetwater River, it can best be described as follows: In the western portion there is an island-like mass of Cretaceous rocks surrounded by Eocene Tertiary beds. The Cretaceous exposure has been caused by an anticlinal fold whose western limit is some distance north of Salt Wells, and which extends in a southern direction nearly to the State line. The exposed core of this fold belongs to the Fort Pierre group, around which are extensive beds of Fox Hills and Laramie formations. On the east flank of this fold are the coal mines at Point of Rocks, Hallville, and Black Buttes; on the west are the celebrated coal mines at Rock Springs. To the west of Rock Springs the Green River Eocene (?) lies conformable upon the Laramie.

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[1] The author is indebted to Prof. W. C. Knight for this summary of the geological features of the Red Desert.

The Green River beds are made up of shales that are cut by deep and almost inaccessible canyons. The canyon of the Green River is at some points more than 1,000 feet deep.

From Black Buttes eastward there is a synclinal basin that is covered with Wasatch and Bridger Eocene, beyond which to the east the Laramie outcrops and extends from the State line north to Green Mountain, forming the eastern boundary of the desert.

The Tertiary rocks covering the basins are quite level, and only form bluffs and escarpments occasionally along the railroad. To the north the country is level for from 30 to 40 miles to where it is hemmed in by high and precipitous bluffs. This rough country extends along the entire northern border. In the northwestern portion the country is very broken, and the castle-like buttes rise to a height of 2,000 to 3,000 feet above the level country.

Oregon Butte is a famous old landmark, and is in reality a mountain made by erosion.

South of the railroad the country is also broken, but is in no way comparable with the northern border.

Another interesting feature is the eruptive overflows in the Cretaceous rocks some 12 or 15 miles north and west of Point of Rocks. The main eruptive mass is known as the Leucite Hills, but there are numerous outlying elevations, such as Pilot Butte, Flat Top, and Black Rock Butte.

SOILS.

The soil of the Red Desert differs materially in the different parts of the region. It is, however, little more than the geological formations would indicate. Probably all the soils of the region must be characterized as saline, but the absolute amount of salts present in any particular locality depends to a great extent upon the conformation of the surface. Through long-continued processes of leaching some formations have lost and others have gained in salt content. Flats and basin-like depressions, receiving the drainage from the slopes, have become more and more heavily impregnated. The rainfall is too limited to carry much of this salt away, so it is found incrusting the banks of the creeks and the margins and beds of the dry or shallow lakes. Some of the abrupt slopes where heavy winter snowdrifts lie are fairly free from injurious salts, and, judging from the appearance of the vegetation, have nearly normal mountain soil. Almost all the soils are poor in humus.

The character of the soil as determined by constituents and water content gives five fairly distinctive formations. These may be designated and characterized under the following divisions:

Plains soils.—Surface more or less undulating, hence fairly well drained and losing slowly some of the soluble salts; soil consisting of clay, gravel, or sand, or these mixed in various proportions. Strictly speaking, it is not a true plain, but undulating or even hilly, with long gentle slopes leading to the basins and ravines. It includes all the land with sufficient slope for drainage.

Alkali soils.—Depressions or basins without drainage and flats adjacent to creek beds; salt constituents increasing; soil, a mixture of fine clay and sand with the salts.

Paludal soils.—Marshy bogs about springs and the margins of some of the few creeks; bogs of all characters from nearly fresh to highly saline or mineralized.

Snowdrift soils.—The draws and abrupt slopes where snow accumulates and lies till late spring or early summer; gravelly or sandy soil, often of a loamy character, due to the considerable amount of decomposing vegetation.

Cedar Bluffs soils.—More or less abrupt slopes of shale, sandstone, or sand; soil inferior, but fairly free from salts; hence a somewhat varied, though stunted, vegetation.

COMPOSITION OF ALKALI IN RED DESERT SOIL.

The analyses[1] of some representative soils from the desert show that they are among the most pronounced of the so-called alkali soils, and that the principal salts are sodium chloride and sodium sulphate, while sodium carbonate, or black alkali, is not wholly absent.

The following analysis of soil for the alkali contents from the desert 21 miles northwest of Rawlins may be taken as fairly representative of the better soils of the Red Desert in general:

Alkali (water-soluble salts), 0.12 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride	18.5
Sodium sulphate	37.1
Calcium sulphate	35.0
Magnesium sulphate	9.4
	100.0

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[1] The author is indebted to Prof. E. E. Slosson, chemist of the Wyoming Experiment Station, for the analyses, and to Professors Buffum and Knight for one each of the samples.

A sample from Bitter Creek flats (second bottom land, on which salt-sages flourish) shows the following composition:

Alkali (water-soluble salts), 0.86 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride	74.1
Sodium sulphate	25.9
	100.0

On the first bottom or low banks of Bitter Creek, on which *Atriplex pabularis*, *Agropyron tenerum*, *Chrysothamnus linifolius*, and one or two species of *Juncus* and *Scirpus* flourish, we find a much greater salt content, as the following analysis shows:

Alkali (water-soluble salts), 8.67 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride	6.44
Sodium sulphate	83.12
Calcium sulphate	5.39
Magnesium sulphate	3.35
Iron and aluminum	1.70
	100.00

As indicating the presence and amount of sodium carbonate, the following analysis of a sample from Orendo Butte will be of interest. The ground from which this was taken undoubtedly has its counterpart in many other localities in the desert:

Alkali (water-soluble salts), 7.20 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride	4.08
Sodium sulphate	50.41
Sodium carbonate	45.51
	100.00

Without giving any more of the analyses in detail, it may be stated that the foregoing do not represent the soils in which the largest amounts of alkali are present and vegetation still existing. In the bed of a dry pond a species of *Scirpus* was growing where the surface soil contained more than 60 per cent of soluble salts.

CLIMATE.

No reliable data are at hand from any locality within the desert either as to temperature or precipitation. On this account only general statements can be made, based upon limited personal observation and such information as could be gathered from the residents of the region.

TEMPERATURE.

The temperature is certainly very variable, rising during the long, clear days of summer to almost tropical heat and falling at night nearly or quite to the freezing point. The dry, rarefied air of these high altitudes permits the free passage of the sun's rays, so that during still days the plains and hills are subjected to almost blistering heat. Radiation being equally unobstructed, all objects soon cool at night.

The high temperature of the day is not oppressive, for it is the direct rays of the sun rather than the stifling heat of a moisture laden atmosphere. Since the atmosphere itself becomes warm only as its moisture accumulates heat in latent form, high temperatures are not reached except in direct sunlight.

This great inequality between day and night temperatures is quite as pronounced in winter as in summer. Very low temperatures are often reached, —40° F. being probably not unknown. The winter, while in some respects not severe, is long; the summer proper, short. Few, if any, months are wholly exempt from frost, and many a hard freeze occurs during the growing season, which follows close upon the melting of the snows in spring.

PRECIPITATION.

The amount of moisture that the region receives is on the whole quite small. During the summer months very little rainfall occurs. Bright, sunny days are the rule. Light showers occasionally fall, but in a few hours afterwards there is little trace of moisture. At this altitude, under the influence of the usual winds and the unobscured sun, the evaporation is simply enormous.

At long intervals occur rainstorms of greater magnitude, sometimes reaching cloudburst proportions. The area covered by them is often as limited as their force is violent. The downpour along the higher ranges of hills and bluffs becomes flood-like. Torrents rush down the slopes, carrying everything before them, into the usually dry ravines and creek beds that for a few hours overflow with a fluid so turbid that the proverbially muddy waters of the Missouri would seem clear in comparison. From this deep, cream-yellow paste there is deposited upon the low banks of the creeks a layer of silt that is pasty and slippery almost beyond belief. This bakes and cracks into hard, irregular bricks, not drying up like ordinary mud. The showers are of little benefit to the locality; the slopes are so abrupt and the vegetation of such a nature that very little of the moisture is held back long enough to penetrate the soil.

By far the most valuable and available sources of water supply are the snows that may occur at almost any time during the year, unless it be during one or two of the summer months. They occur rarely during the early fall, occasionally during the winter, and more frequently during the spring months. These usually melt so gradually that all their moisture, except such as is lost by evaporation, finds its way into the soil.

Especially helpful to the vegetation of the desert are the snows of late spring. These lie like a wet blanket over everything for a few days at a time, completely saturating the soil and providing an abundance of moisture for the rapidly developing vegetation.

Sometimes, usually in late winter or early spring, but liable to come at any time, there occur snowstorms of great severity—blizzards which last from one to three days. Inasmuch as these are accompanied or followed by high winds, the plains or level stretches are soon blown bare, the snow being piled in great drifts under the brow of some range of hills, in the many draws and ravines, and to the leeward of patches of sage-brush and grease-wood.

WATER SUPPLY.

To say that the water supply is very limited and of poor quality is hardly necessary. The name of the region and the names of its creeks tell the tale without comment. Bitter Creek, with its tributaries, constitutes the drainage system. This creek originates in the height of land in the southeastern portion, takes a westward course, and, after a tortuous journey of probably 75 miles, empties into Green River.

Probably at no time is it quite dry, but in no part of its course, except in flood time, is it so wide that one can not in many places step from bank to bank. Its only tributary from the north is Killpacker Creek, while from the south it receives Little Bitter Creek and South Bitter Creek. The latter is very generally called Salt Wells Creek, but in character of water is very similar to the others, and in size almost equals the main stream.

In the northern part of the desert a few other small creeks originate, but they are all entirely lost in the sandy depressions toward which they flow or in the nearly dry alkali lakes which they feed. The names of these are suggestive, such as Lost Creek, Alkali Creek, Lost Soldier Creek, Separation Creek, and others nearly as significant.

As may be expected, the waters of these creeks are practically saturated solutions of the soluble mineral ingredients found in the soils of the tributary basins. At no time either during flood or drought are their waters suitable for domestic use.

There are, however, within the region a number of springs, or rather groups of springs, but these are often at great distances from each other. The waters of most of them are of a mineral character, iron and sulphur being of most frequent occurrence. These latter, with the few non mineral springs, furnish the available potable waters of the region, at present at least, with one exception noted below.

If the surface waters are bad, the artesian waters are not much better. The Union Pacific Railroad Company has put down wells at several points between Rawlins and Green River, some of which furnish an abundance of water for steam purposes, but so far only one has been found suitable for domestic use. This one, located at Point of Rocks, furnishes an almost unlimited supply of "good" sulphur water. It is the only source of water supply for all stations between Rawlins and Rock Springs, the latter securing its water from Green River by pipe line. To a score of stations and section houses, covering 121 miles of the road, water is hauled in cars and emptied into cisterns, from which it is drawn as needed. When exposed to the air it loses to some extent its sulphurous odor and taste. In this region the emigrant trail runs parallel to the railroad, and the dusty traveller and the thirsty horses refresh themselves at the oft-recurring and generous cisterns.

EXTENT OF SETTLEMENT.

The population of the desert is small, and from necessity will not for some time at least be greatly increased. Outside of the towns and stations on the Union Pacific Railroad there are not in all this 11,000 square miles more than 200 inhabitants.

Nearly the whole population of the region is found in immediate proximity to the railroad. To this population the railroad and commercial and official interests, together with the coal-mining industry, give employment in large part. However, a number of men who have stock interests of greater or lesser magnitude in the country make their homes in the towns. The remnant of population outside of these is found upon widely separated ranches, which are scattered over the desert where the occasional springs of usable water permit, or, more frequently, along its borders where streams of fresh water come down from the hills, making possible the well irrigated and successful ranch.

At a very few of the springs that are not too distant from the towns there have been established highly successful and profitable gardens and truck farms. The products of these oases find a ready market in Rock Springs and other points upon the railroad.

The increase in the population of the desert will be largely an increase in the size of the towns. While the range interests of the region are capable of considerable expansion, yet those who may engage in the stock industry will, for many reasons, more frequently make their homes in the towns than upon the borders of the desert, remote from the conveniences of civilization.

PLANT FORMATIONS.

The region shows no well-marked plant formations or areas except such as are bounded by soil conditions; that is, the character of the vegetation of one part of the desert as compared with another, depends upon soil constituents and amount of water. Considered from this standpoint, the following grouping may be serviceable in pointing out the characteristic vegetation:

VEGETATION OF THE DIVISIONS OF THE DESERT.

Plains division.—Under this designation may be included nearly three-fourths of the entire desert. The vegetation here is easily distinguished from that of the rest of the desert. The most characteristic vegetation is the common sagebrush (*Artemisia tridentata*), which grows in all the soils which are less strongly impregnated with salt. With this are other sages, most important among which is Bud-brush (*Artemisia spinescens*). Altogether the most valuable plant, however, is Nuttall's Salt-sage (*Atriplex nuttallii*). This constitutes a large part of the forage of the region. With the foregoing must be mentioned Winter Fat (*Eurotia lanata*), Shad Scale (*Atriplex confertifolia*), the Rabbit-brushes, or Green-sages (*Chrysothamnus*), and a few other shrubby plants (*Tetradymia*, etc.). Besides this shrubby vegetation there are a number of grasses that form a somewhat scattering growth. Most prominent among these are the Wheat-grasses (*Agropyron*) and Indian Millet (*Eriocoma cuspidata*).

Alkali division.—Next in importance are the plants on the strongly alkaline soil, the land immediately bordering the creeks, the low flats adjacent, and the shallow dry lake beds. Here we find sagebrush largely replaced by Grease-wood (*Sarcobatus*), and with this a great admixture of Salt-sages (*Atriplex*) and a few species of rushes and sedges.

Paludal division.—This includes the occasional spring bogs and creek marshes where occurs a dense growth of grasses, sedges, and rushes, including a large number of species.

Snowdrift division.—This comprises the areas of permanent winter snows, that is, the deep "draws" and abrupt slopes where snowdrifts pile upon snowdrifts. Here, besides Sage-brush, are found occasional clumps of Choke-cherry, Service-berry, Mountain-mahogany (*Cercocarpus*), etc., besides a great profusion of herbaceous vegetation, including many valuable grasses and sedges.

Cedar-Bluffs division.—On some of the higher or at least the more abrupt hills and slopes occurs a scattering and stunted growth of juniper, a scraggy shrub or small much-branched tree. Scattered among the junipers are various small shrubs and occasional patches of fine grass.

DISTINCT TYPES OF VEGETATION.

In the preceding outline no attempt has been made to draw attention to any except the more enduring and therefore the vegetation of most economic importance. To understand the flora of the region one must consider two somewhat distinct types:

Persistent vegetation.—Those plants which are more or less in evidence throughout the year.

Transient vegetation.—All those plants which spring up each year from seed or from such underground parts as bulbs, tubers, or rootstocks. Most of the plants of this character spring up quickly, blossom, bear fruit, wither, and disappear for the rest of the year. These plants far outnumber the persistent type. This transient vegetation follows close upon the retreating snows. The warm sun of the many bright days of spring and the grateful moisture coax out a few forms in April, while in May the wild mustards, beans, chickweeds, composites of many kinds, Pentstemons and Eriogonums troop forth in great profusion on all the slopes. These, however, soon succumb to the unobscured summer sun. By the end of June most of them are dead and blown away, only a few seed stalks lingering to tell the tale of what has been.

FORAGE.

The Red Desert is distinctively a stock region. Outside of the few favored spots kept fresh by springs, there are no farms or gardens.

From the 1st of June till the 1st of November the region is practically devoid of stock of all kinds. With the coming of the snows the herds and flocks are worked back into the desert from the summer pastures in the hills and mountains. Through the winter and spring months thousands of head feed upon this rough forage, the snowdrifts furnishing the water for all. The sheep herder in his wagon, also dependent upon the snows, guides his flock from district to district as new pasturage is needed. By the time the stock is taken to the summer range the desert is barren indeed. Grasses, sage-brush, salt-sage, white-sage, rabbit-brush, and even cedar boughs have been grazed so close that every edible sprig is gone.

AMOUNT OF FORAGE.

The number of head of stock that the vegetation of a district will support gives some idea of the amount of forage produced. While giving no facts in pounds or tons, yet relative estimates may be secured. Since the desert neither occupies the whole of any one county nor is confined altogether to a single county, no statistics separate from those of the several counties which are in part within the desert can be given. The desert includes a large part Sweetwater County, a county somewhat smaller than the whole of the desert. The following official figures for this county, showing the number of head of stock supported, will, therefore, be a fair estimate for the desert as a whole. The figures are given for three years, in order to show what may be expected from its forage one year with another.

Stock supported in Sweetwater County.

Year.	Horses.	Mules.	Cattle.	Sheep.
1895	1,918	92	2,802	158,050
1896	2,030	246	2,227	170,290
1897	1,640	72	1,882	166,843

Besides this stock, there are trailed through this county each year from 150,000 to 200,000 sheep. These are driven along slowly, the passage of some of the flocks through the county occupying weeks.

During the winter months the adjoining counties, especially Carbon County, and the adjoining States—Colorado, Utah, and Idaho—greatly swell the total of the stock that feeds within the desert. Flocks of sheep are brought in from all directions, and while of these there has not up to the present been any official record, yet enough is known to indicate that the estimates of the most conservative sheepmen are too low rather than too high. These place the total number of sheep in the desert, during some five months of the year, at 300,000 to 500,000. Some estimates for the winter of 1896–97 were as high as 800,000.

Of the surrounding counties, Carbon County sustains the closest relation to the Red Desert. A portion of the county is included in it, and its large flocks of sheep either feed in the desert proper or on vegetation similar to that of the desert during the winter season. The following official returns show what this vegetation will support.

Stock supported in Carbon County.

Year.	Horses.	Cattle.	Sheep.
1895	6,248	22,750	288,115
1896	6,511	20,991	354,804
1897	6,565	18,992	366,521

The figures from the two adjoining counties, Fremont and Uinta, will give further evidence on the question, for flocks from these also feed at times within the desert. To make clearer the relation of the Red Desert to the stock interests the returns from these counties are given.

Stock supported in Fremont and Uinta counties.

FREMONT COUNTY.

Year.	Horses.	Cattle.	Sheep.
1895	9,700	27,279	93,300
1896	9,858	31,957	114,164
1897	5,269	9,770	137,765

UINTA COUNTY.

Year.	Horses.	Cattle.	Sheep.
1895	5,521	19,313	157,435
1896	4,964	18,923	202,336
1897	4,803	17,577	212,829

It should be noted that the large loss in cattle and horses for Fremont County in 1897 is due to the fact that the recent establishment of Bighorn County has transferred to it much stock that prior to 1897 was assessed in Fremont.

The figures given for Carbon, Fremont, and Uinta counties are the actual assessments, and do not cover a considerable number that probably escape enumeration each year, nor those flocks temporarily in these counties as "trail" sheep.

QUALITY OF FORAGE.

The quality of forage, as judged by results, is of the best. Horses, cattle, and sheep do well. If the winters are not too severely cold nor the snow too deep, all kinds of stock not only subsist upon these plants but actually remain in good flesh throughout the winter. Of the grasses that cure upon the ground the Wheat-grasses are the most abundant, and these have long been known to possess high nutritive value. It is, however, the shrubby vegetation that furnishes the largest amount of valuable feed. Such plants are much more succulent than appearances would indicate. Growing on strongly saline or alkaline soils. the Salt-sages and many other plants take up these salts in such quantity that one readily detects them on tasting even a small fragment of a leaf.

Stock feeding upon such plants secures the necessary amount of salt from the food, so that the salting of stock that must be resorted to during the months when the animals are feeding upon the mountain grasses is wholly unnecessary.

MEANS FOR IMPROVEMENT OF THE FORAGE.

How to improve the quality and increase the quantity of available forage in the Red Desert is a most difficult problem. The soil conditions and water supply are such that not much may be hoped for through the expenditure of ordinary effort and means for the desert as a whole. Nor will any sudden or spasmodic effort suffice. Only forces and plans operating for a number of years can be expected to give noticeably great results.

It is very evident, however, that the forces now at work are tending toward improvement. According to the most reliable sheep men the same areas that twenty years ago would only support one sheep will now better support from three to five. This they attribute to gain in the strength of the soil due to the accumulating manure. It seems probable that a more potent factor is found in the following: The vegetation chiefly depended upon for forage is composed of the large number of small shrubs of many kinds previously mentioned. The cutting down to the ground of such vegetation enormously increases the number of annual shoots. From winter to winter this shrubby vegetation has been browsed down closer and closer to the woody bases of the plants, until now the tender annual shoots are produced in much greater abundance. The effectiveness of this browsing is, of course, dependent upon the region being used as a winter pasture only, giving time for growth and recovery each summer.

Something can certainly be done in a small but effective way in the vicinity of those ranches that are now found within the region, or such as may yet be located. Salt-sages or other alkali-enduring vegetation, if the ground be seeded to them, can be made to yield much more heavily than at present. For this purpose either native or valuable introduced forms (discussed elsewhere in this report) may be used.

The native grasses also are worthy of trial. The writer has seen wonderful results from seeding the ground to some of these, especially the wheat-grasses, and this, too, where the water used for irrigation was far from the best and the ground strong with alkali. Furthermore, the increase in the water supply is not quite hopeless. The region contains many natural basins in which, by the expenditure of a little labor in the construction of dams, much of the water from the accumulated winter snowdrifts might be saved for use later in the season.

On the outskirts of the desert, the problem is much the same as in the greater arid west. Those measures which may be successfully introduced in other localities will be equally successful here.

CHARACTERISTIC DESERT PLANTS.

A question needing full investigation is the relation of plants to alkali or other salts in the soil. Practically all that we know is that some species have adapted themselves to endure or even thrive in soil containing greater or less amounts of various salts. Different species even in the same genus behave very differently in this respect; for example, *Chenopodium album* L. seeks a soil free from salts, while for *C. glaucum* L. there can hardly be too much. If alkali affects a plant injuriously it seems to do so throughout its entire development. It has been shown that alkali retards germination or entirely prevents it in most seeds in direct proportion to the amount of the salt present.[1] Some families of plants have adapted themselves to saline soil more than others. Easily first in this respect is the goose-foot family (*Chenopodiaceæ*). To this belong a large number of distinctively alkali plants, such as the Salt-sages, White Sage, Grease-wood, Russian Thistle, and Australian Saltbush.

In regard to the question of largest representation by species of the families of plants found in the desert, the writer found on examining the collections that the family represented by the largest number of species is not necessarily the most characteristic of the region. The obvious vegetation, that which gives character to the landscape, can be included in a half dozen genera, *Artemisia*, *Tetradymia*, *Chrysothamnus*, *Atriplex*, *Sarcobatus*, and *Agropyron*. Remove all the plants belonging to the three families, *Compositæ*, *Chenopodiaceæ*, and *Gramineæ*, and the region would look like a true desert. Many other families are better represented in number of species, but the individuals are either small or scattering, and bear the same relation to the great mass of vegetation that the occasional weed in a well-tilled field bears to the main crop.

The plants of the following list are worthy of special note. It is intended to include only those that are of first importance either because of the large amount of forage produced or because of their great nutritive value and those that give promise of good results under cultivation. They are here arranged rather in the order of importance for the two regions: (1) Vegetation of the desert, or winter, range (see Pl. I); and (2) vegetation of the hill country, or summer, range (see Pl. II, fig. 2).

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[1] Bull. 29, Wyoming Experiment Station.

VEGETATION OF THE DESERT, OR WINTER, RANGE.

(1) **The Salt-Sages.**—The salt-sages rank first in the amount of forage produced, and, judging by the number of cattle supported on the winter pastures and the reported fine condition of the stock, these plants possess high nutritive value.

NUTTALL'S SALT-SAGE (*Atriplex nuttallii* S. Wats.).—Of the several species, this stands first in the matter of distribution. It is found nearly everywhere except on the most pronouncedly alkali ground. It belongs not only to this desert and this State but is the most generally distributed salt-sage of the entire arid west. It is the sheepman's most highly-prized winter forage, and certainly here furnishes one-half of the whole supply. Sheep thrive upon it both when it is green and also in the winter after it has cured upon the ground. It is a perennial with a woody base, calculated to endure severe pasturing and much trampling. It is each year eaten down to the ground, leaving only the woody base. It produces seed in abundance, which is greedily eaten, and this probably accounts for its high nutritive value. It seems unsuited for cultivation, except where a perennial pasture is desired, on account of its woody character and slow growth, but where well established it is a source of much feed for all kinds of stock and should not be carelessly destroyed.

NELSON'S SALT-SAGE (*Atriplex pabularis* A. Nels.).—This new species seems to be a form of great promise as a forage plant. Like the preceding, it is a perennial, but the woody base is almost wholly underground. The herbaceous stems are produced in much greater abundance, forming often a close, continuous, erect growth. So far as known it is not widely distributed, being confined to strongly saline areas, such as the flats adjacent to Bitter Creek and its tributaries and the dry beds of alkali basins. It fruits freely, makes a considerable annual growth, and is certainly worthy of trial with a view to forming a permanent pasture on otherwise valueless alkali ground. Its habit of growth would also make it possible to harvest it by the methods applicable to the grasses. Sheepmen unite in pronouncing it prime forage.

TUMBLING SALT-SAGE (*Atriplex volutans* A. Nels., Pl. III, fig. 2).—This heretofore overlooked annual may prove a more valuable plant for certain alkali soils than any of the foreign species that have been so highly recommended. It is a plant of rank growth, and when not crowded, forms in one season a compact subspherical mass 3 feet or more in diameter. If left to mature on the ground the slender tap-root breaks in the autumn and the plant becomes a tumble-weed. After that time it has probably little nutritive value. If it is ever utilized as a forage plant it must be harvested shortly before maturity. If closely grown this would not be difficult with ordinary machinery. It produces a great abundance of seed that could be thrashed out with very little trouble.

SPINY SALT-SAGE (*Atriplex confertifolia* S. Wats.).—To see this spiny shrub one would hardly think of it as a valuable form of forage, yet sheepmen look upon it as such. They say there is no fault to be found with it except that "there is not enough of it." It is popularly known as Shad scale. It belongs peculiarly to the desert region, where it is eagerly sought in late spring for its tender shoots and leaves. The large quantities of leaves and fruits produced during the summer months are mostly dropped before autumn, but are collected by the winds into little piles under the shrub or in the little hollows of the plain. These the sheep eagerly seek, so that where a band of sheep has fed it is difficult to find either leaves or fruit.

(2) **The Sage-Brushes** (*Artemisia*).—The amount of sage-brush consumed in the desert is simply amazing. Sheepmen and herders say that for sheep a straight sage-brush diet at certain times seems to "meet a long felt want." Whole bands will leave all other forage and browse sage brush for a day or two at a time, after which they will not touch it again for some days, or even weeks. This is especially true of the common sage-brush (*Artemisia tridentata* Nutt.), while some of the other species are so much sought after at all times as to need special mention.

BUD-BRUSH, BUD-SAGE (*Artemisia spinescens* Eaton).—This is the sheepman's "bud-brush." It grows to the height of only a few inches from strong, woody, underground parts. It puts forth numerous leafy stems, profusely covered with clusters of yellowish flowers. The large, bud-like clusters of flowers have suggested the common name. It develops early, being at its best by the end of May. It is said that sheep run hastily from clump to clump in search of this succulent morsel.

SILVERY-SAGE (*Artemisia cana* Pursh).—This in quality probably does not differ materially from the common sagebrush, but, in proportion to area occupied, it produces much more forage. It is found chiefly in the alluvial soil on the banks of streams. Its forage value is due to the production each year of a very large number of long, slender, tender shoots, which are eaten at intervals, as before stated.

(3) **Wheat-Grasses** (*Agropyron*).—For quality these grasses would take first place in the desert forage, but the amount is quite limited.

They cure readily on the ground, and remain more nearly intact throughout the winter months than any of the other grasses of the region. The species of most importance are given as follows:

SLENDER WHEAT-GRASS (*Agropyron tenerum* Vasey).—This wheat-grass is very generally distributed throughout the area. It is found in all parts of the desert, as well as in the better soils of the summer range. It grows in dry, poor soil, but thrives better in good soil, and responds readily to cultural advantages. A moderate amount of water in irrigation produces best results on this grass. It will hardly stand flooding at all. For pasture purposes there are grasses that will endure more hard treatment than this, but as a meadow grass it must be given first place. It often forms a close, uniform growth that yields as much per acre as an average field of timothy. Considering its high nutritive value, no more profitable grass can be found than this for the desert region, especially on saline soil and where the quantity of available water is limited. While not seeding very freely, the requisite amount for sowing can easily be obtained after the first crop has been harvested. It is easily thrashed out in a machine, or may be flailed out if no better method is at hand. Seed of this grass is now on the market.

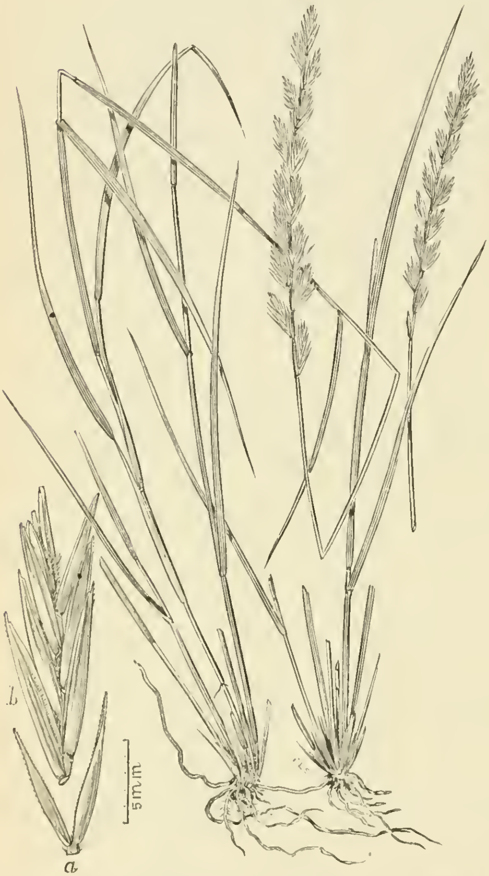


FIG. 1.—Western Wheat-grass (*Agropyron spicatum*): *a*, empty glumes; *b*, florets.

COLORADO BLUE-STEM, WESTERN WHEAT-GRASS (*Agropyron spicatum* S. & S., fig. 1).—This grass is capable of enduring drought to a remarkable degree. Naturally, however, it makes a very sparse growth. Distributed rather generally throughout the region, it is found occupying the driest banks and bench lands. It is capable of rank and dense growth under favorable conditions, as shown in irrigated meadows, where it occurs as the principal grass. Best results will be secured on second bottom lands with moderate water. Flooding should be avoided.

(4) **Indian Millet** (*Eriocoma cuspidata* Nutt., fig. 2).—The value of this grass has been greatly underrated. It is not only widely distributed, but manages to make a fair growth in desert places, where other grasses are almost wholly absent. It develops early and keeps in fair condition throughout the season. Under favorable conditions it grows to a good size, but even dwarf specimens fruit freely. All kinds of stock relish it, but horses are particularly fond of the seeds, and will go from bunch to bunch cropping out the heads. On sterile and stony ground it may prove more profitable than any other that could be sown.

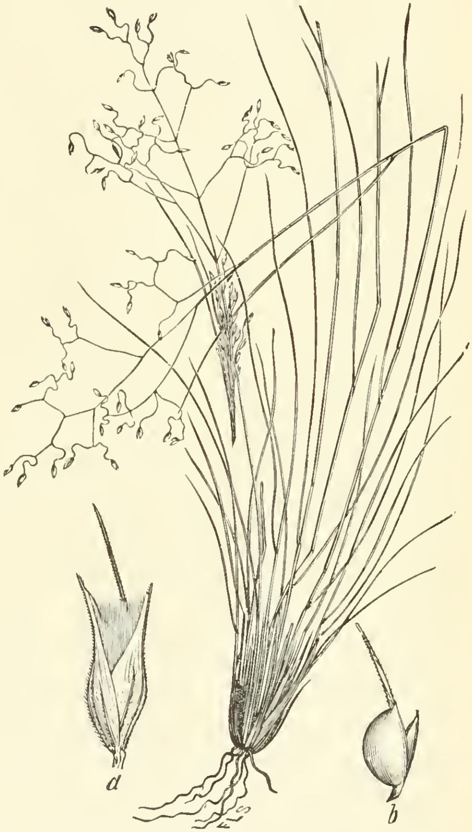


FIG. 2.—Indian Millet (*Eriocoma cuspidata*): *a*, spikelet; *b*, floret.

(5) **Giant Rye-Grass** (*Elymus condensatus* Presl).—This is worthy of note because of its conspicuousness rather than its great forage value. To the casual observer this is the grass that would characterize certain localities. It would be thought of as a part of the general relief of the region. The dense bunches, sometimes 5 to 7 feet in diameter and 6 feet high, stand out very prominently on otherwise naked slopes. It is found all the way from creek banks to the deep "draws" and slopes where snowdrifts accumulate. As forage it is eaten to some extent while young, but becomes unpalatable and harsh as it matures and cures on the ground. It is considered valuable as fodder if cut and cured before it matures. In this condition it is fed to advantage to cattle and horses through the winter months. Possibly if sown thickly and harvested early it might be profitable on account of the quantity produced.

(6) **Desert Juniper** (*Juniperus knightii* A. Nels.).—To list a tree of any character as a noteworthy forage plant is at least a little unusual. This scrubby, shrub-like juniper, or, as it is usually called, "bluff cedar," has, however, saved many a flock of sheep from extinction. During some of the terrible blizzard-like snowstorms that occasionally occur and last for two or three days the only available forage consists of the branches and tops of this Juniper. The experienced herder keeps working the sheep about, so as to have them on top of the snowdrifts instead of under them. Gradually a trampled-down yard is formed, which, if it be among the cedars, will enable him to hold his flock for some days safely. "Cedar boughs" are not refused under such circumstances, and if not very nutritious, they at least fill the stomachs of the hungry animals.

VEGETATION OF THE HILL COUNTRY, OR SUMMER, RANGE.

A complete discussion of the forage of the vast area which constitutes the summer range of the flocks and herds that winter in the desert is not called for in this report, and would necessitate a more critical investigation in the field of the plant formations that characterize the different areas than they have yet received. Enough is known, however, to enable one to state the character of the forage with a degree of certainty.

It may be said then, first of all, that the summer forage is distinctively herbaceous, strikingly in contrast with the more or less shrubby vegetation of the desert; that it consists primarily of grasses, sedges, and rushes, in contrast with the woody plants of the winter range.

The summer range consists of the mountainous and hilly areas on the outskirts of the desert. It does not include the impenetrable and rugged fastnesses of the higher ranges, such as the Medicine Bow, the Wind River, and the Uinta, but mountains of medium elevation, with rounded slopes, only partially wooded, and well watered with springs and creeks. The timber upon such is open, or, if dense, is interspersed with parks or meadows of most luxuriant growth. Here is a grove of quaking aspen, there some scattering pines, and yonder a spruce-covered summit. In the narrow valleys springs and snow-fed streamlets are found on whose banks occasional clumps of willow or alder occur. In these regions grasses flourish as they never do on the plains. The better soil and the frequent summer showers furnish the conditions for luxuriant growth. Of grasses there are many genera, of which the following are the more valuable:

The Spear-grasses (*Poa*) are easily first as to number and value. After these come a number of groups, all of great value, or at least containing one or more valuable species. Among these are the Brome-grasses (*Bromus*), Wheat-grasses (*Agropyron*), Rye-grasses (*Elymus*), Dropseed grasses (*Sporobolus*), Timothy (*Phleum*), Manna, or Reed, Meadow-grasses (*Panicularia*), Blue-joints (*Calamagrostis*), Hair-grasses (*Deschampsia*), and Bent grasses (*Agrostis*).

(1) **The Spear-Grasses** (*Poa* species).—The Spear-grasses, of which there are many valuable species, are most abundant in the hills and mountains and along water courses, but they are not absent even in the desert. In looking over the large list of species secured and the field notes upon them, I find myself unable to fix upon any one as preeminently the most promising or valuable. Some have a wide and general distribution, but are of scattering growth. Others, more local, grow luxuriantly, and for their particular localities stand first. All must be reckoned as pasture grasses of first importance. Some are meadow grasses of importance, especially in native meadows, but for cultivation for hay greater returns can probably be secured from other kinds of grasses. Among those of very general distribution may be mentioned Bunch-grass (*Poa buckleyana*), Alkali Blue-grass (*P. juncifolia*), Smooth Bunch-grass (*P. laevigata* Scribn.), Wood-Meadow grass (*P. nemoralis* L.), Kentucky Blue-grass (*P. pratensis* L.). The last mentioned is undoubtedly native in a large part of the Northwest. In many native meadows and pastures, along water courses, and in the foothills it forms an important part of the sod, and occasionally makes quite a rank growth. Among the more local but very valuable Spear-grasses are Western Blue-grass (*Poa arida* Vasey), Fowl Meadow-grass (*P. flava* L.), Shiny Bunch-grass (*P. lucida* Vasey), Sheldon's Blue-grass (*P. sheldoni* Vasey), Mountain Meadow-grass (*P. reflexa* Vasey & Scribn.), and Wyoming Blue-grass (*P. wheeleri* Vasey). Of these last *P. sheldoni* appeared the most promising, as seen in the field. It is one of the most important grasses of this range, forming a large percentage of the forage on the park meadows among the hills. It is freely eaten by stock and seems to hold its own under the severest pasturing.

(2) **The Brome-Grasses** (*Bromus*).—The several species of this genus are hardly thought of as pasture grasses on account of their rank growth. Some of the mountain species, however, are valuable as summer forage, while they are also plants of great promise for meadows. Some of the species are well known and have been successfully introduced into many localities. It seems possible, however, that the best are yet to be introduced. Of the eight species collected in the area under consideration, a form common in the Sierra Madre Mountains and their westward extension on the Colorado-Wyoming line seemed by far the most promising:

LARGE MOUNTAIN BROME GRASS (*Bromus multiflorus* Scribn.).—This is a most striking grass, one that attracts attention at once in a region where fine grasses are the rule. This is the grass that characterizes the locality. To the general observer this would be recalled as the grass not only peculiar to but distinctive of the region. The miners think of it as the feed that their horses subsist upon. It grows upon the hillsides among the fallen timber. It is hardly abundant enough in any locality to form a continuous meadow, but if cut would, on account of its size, supply a fair crop of hay. Horses eat it with avidity and seem to do well upon it. They prefer it to the other abundant grasses of the locality. It was collected at altitudes between 9,000 and 10,000 feet in the parks and open woods, localities in which vegetation hardly starts before June, for almost until that time snow covers all. In consequence of its habitat it matures late, but if introduced into lower altitudes it would undoubtedly prove as early as other grasses of its kind. It grows to a height of 3 to 4 feet, produces an abundance of leaves, and if it would thrive under cultivation as well as in its native habitat it would give an enormous yield.

(3) **Dropseed** (*Sporobolus depauperatus* Scribn.).—This grass grows along streams, in the foothills, and open parks in the mountains, and even in some of the draws in the desert. It forms a close dense sod, especially where it is freely pastured. On many bottom lands it is the prevailing grass. All kinds of stock seek it out, so that it is difficult to find mature specimens except on inclosed grounds. It seems that it might be introduced with profit into most pastures not only in the mountain regions but generally elsewhere as well. It might also prove valuable as a lawn grass in places where water for irrigation is limited or in lawns that have to endure much trampling. It is possibly a little harsh for this purpose, but frequent cutting would thicken up the sod and reduce the harshness to a minimum.

(4) **Reed Meadow-Grass** (*Panicularia americana* MacM.).—Among the several manna-grasses this seems by far the most valuable for this region. It is probable that its value as a meadow-grass is not appreciated. For exceedingly wet ground it must prove especially desirable. Here is a grass that will stand flooding. It is adapted to land that is submerged during the growing season, and only needs it to be dry in time for harvesting. It is quite abundant in some localities, and if it were introduced to take the place of the sedges and rushes that so abound in wet or flooded meadows there would be a distinct gain in both quantity and quality of the hay. On Mr. Jacob Johnson's ranch, where it was particularly observed, it occupies many acres. It was being mown at the time, and was accounted one of the most valuable hay grasses. Horses relish it greatly. They were seen wading in mud and water to their knees to secure this when other excellent grasses were superabundant.

(5) **Redtop** (*Agrostis alba* L.).—Presumably introduced and undoubtedly sown in some meadows, but so widely distributed and in such out-of-the-way places as to indicate that it is also indigenous in the State. It thrives in low, wet ground, and will stand flooding much better than most of the other valuable grasses. It forms a large percentage of the meadow-grasses on the Bear River bottoms. To

substitute it for the sedges and rushes in the meadows of the Laramie river would be the part of wisdom. With this and the tall Reed Meadow-grass the wettest ground could be utilized.

(6) **The Sedges** (*Carex*).—Of this genus the region affords a very large number of species. They are of varying abundance and value, but it is hard to select, even after observation in the field, the most profitable. Many of them are cut for hay and certainly have nutritive value, but they are hardly to be compared to the better grasses. In many fields, however, they have almost replaced the grasses owing to over-irrigation. The senseless manner in which the water is applied to some of the grass lands must be attributed either to ignorance or indifference. Early in the spring, while the ground is still wet and cold, the lands are submerged and kept in that condition through the season, and are only drained in order that the mowing machines may be taken into the fields. A few seasons of this kind of treatment gives the land over to sedges and rushes and makes it reclaimable with the greatest difficulty. For lands that are naturally wet some species of Carex may be found better adapted than the true grasses, at least in certain kinds of soil. Among those that are peculiarly adapted for hay purposes may be named *Carex athrostachya* Olney, *C. festiva stricta* Bailey, *C. lanuginosa* Michx., *C. marcida* Boott, *C. nebraskensis* Dewey, *C. trichocarpa aristata* Bailey, and *C. utriculata minor* Boott. The dense growth of leaves in *C. lanuginosa* and *C. trichocarpa aristata* makes them particularly desirable for hay. The latter yields enormously in some of the fields on the Laramie bottoms. For a pasture sedge there is nothing to compare with *Carex media deflexa* Bailey. It belongs in the mountains, in the open parks, and on the ridges at 9,000 feet and upward. In such places it forms close mats several feet across, and these in places almost touching each other. It grows to only a few inches in height, but produces an abundance of leaves and fruited stems that are much sought after by stock of all kinds. Where it is accessible to stock it is hard to find matured, or fruited, specimens. There are forage plants of more or less value among the rushes, the legumes, and in a few other groups, but these will be noticed in their order in the systematic list.

LIST OF THE FORAGE PLANTS OF THE SUMMER RANGE.

The following grasses and forage plants were collected on the summer range (the hill country bordering the desert) during the season of 1897:

GRASSES.

Panicum virgatum L. (SWITCH-GRASS, fig. 3).—A grass with rather rigid, wand-like, few-leafed stems, 20 to 30 inches high, the fruiting pedicels slender, spreading, the spikes of few but large seeds. Probably rare in the State, as it has been secured only near the Nebraska border. Pine Bluffs, July 6 (3626).

Phalaris arundinacea L. (Reed Canary-grass).—A tall, handsome grass, 3 to 5 feet high, with ample, green leaves and long, close panicles. It occurs in wet ground along ditches and creek banks, in shallow bogs and ponds; nowhere observed in abundance, and therefore in its native state of little economic importance. Johnson's Ranch, Big Laramie, August 7 (3910); Grand Encampment Creek, August 13 (3987).

Savastana odorata Scribn. (Seneca-grass, fig. 4).—A small grass, 6 to 12 inches high, with large heads; whole plant emits a delightful fragrance. It occurs in cold, swampy ground from middle to high altitudes, sometimes in such quantity as to constitute a perceptible part of the forage. Willow Creek, May 22 (2908).

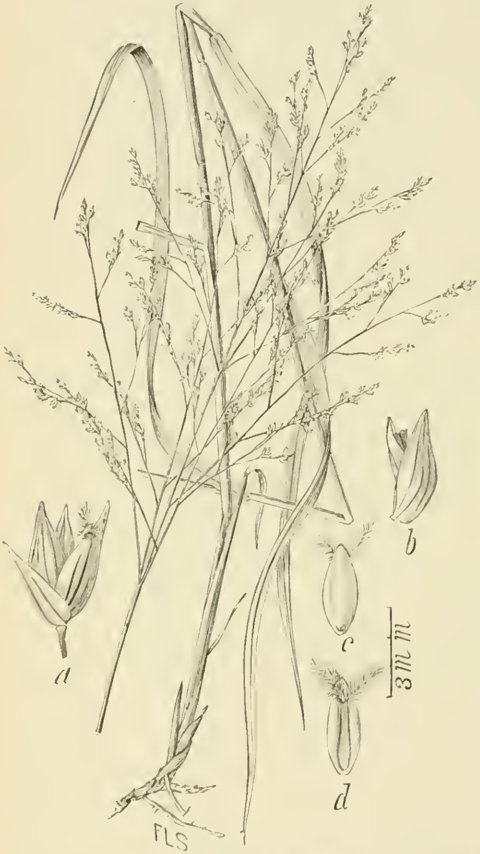


Fig. 3.—Switch-grass (*Panicum virgatum*): *a*, spikelets; *b*, staminate floret; *c*, floret; *d*, anterior view of same.

Aristida fasciculata Torr. (Purple Beard-grass).—A closely tufted grass, with slender, very numerous stems, short, slender leaves, the heads with long, divergent awns. Not of frequent occurrence in the State, but in one locality very abundant, where it occupied the dry foothills, especially the loose, broken ground. Pine Bluffs, July 6 (3617).

Stipa columbiana Macoun (Columbian Needle-grass).—A bunch grass with numerous long leaves, the upper part of the stems naked and bearing a long panicle with awns of moderate length, 2 to 3 feet high. It is a rare grass and was sparingly found in scattering bunches in the open woods on the Medicine Bow River, August 20 (4074).

Stipa comata Trin. & Rupr. (Needle-grass). — One can scarcely think of this tufted grass, with its long, twisted awns and barbed seeds, as anything but a pest, but stockmen assert that it is valuable for pasture before it heads, and that if cut after the "seeds" have dropped it forms a good quality of hay. It is very abundant on the plains and in the dry foothills of the eastern part of the State. Pine Bluffs, July 5 (3603).

Stipa nelsoni Scribn. (Nelson's Needle-grass).—This grass belongs to the summer range especially, but it was also secured within the Red Desert. In the wooded, mountain areas it attains to greater luxuriance and is of more frequent occurrence. Woods Creek, August 9 (3963); Battle Lake, August 17 (4059 and 4060).

Stipa minor (Vasey) Scribn. (Purple-top Needle-grass).—A bunch grass with numerous slender root leaves, slender, somewhat wiry stems terminated by long heads with divaricate and variously twisted or bent awns of moderate length. The root system, with the dead leaves and stems of the previous year, forms a firm, harsh mat, from which the new stems and leaves arise, 15 to 25 inches high. It seems to belong to the mountain slopes in the region of permanent winter snows, especially among the fallen timber on partially open hillsides. It is not known whether the awns are such as to lessen its forage value. "G." Summer ranch, July 23 (3828); Battle Lake, August 16 (4026).

Stipa tweedyi Scribn. (Tweedy's Stipa).—A bunch grass of spreading habit with long, geniculate, bent awns; stems 20 to 30 inches long. In general appearance it much resembles *S. comata*, and its forage value may well be compared with that. Sheep Mountain, July 3 (3297).

Stipa viridula Trin. (Feather Bunch-grass).—A tall, coarse bunch-grass, with a long, close panicle, awns bent, of moderate length, seeds falling early. It occurs in the eastern part of the State on the dry, open plains, but never in any great abundance. Pine Bluffs, July 6 (3613).

Oryzopsis micrantha Thurb. (Small-flowered Mountain Rice).—A rather handsome, slender, spreading grass with long, slender root leaves, panicles loose and spreading, the spikelets on slender, divaricate pedicels, mature seeds large. This was secured but once, among the broken rocks in the bottom of a dry canyon. It must be of excellent quality, and if it would thrive under cultivation it would form a valuable addition to our forage plants. Pine Bluffs, July 6 (3615).

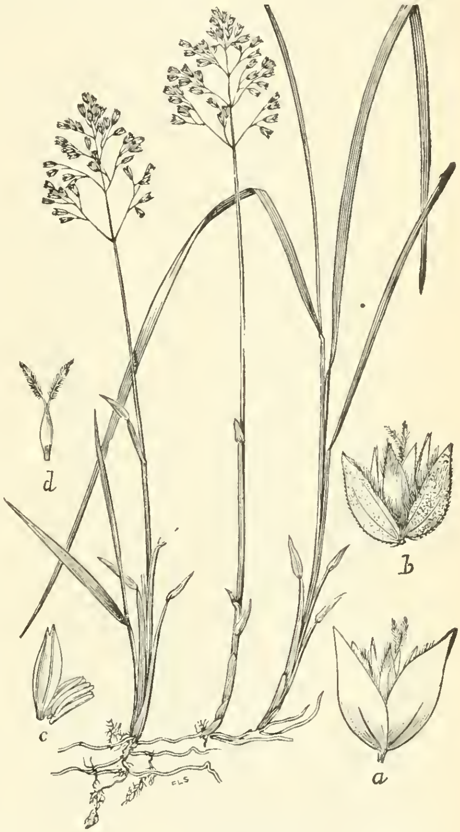


Fig. 4.—Seneca-grass (*Savastana odorata*): *a*, spikelet; *b*, florets; *c*, palet; *d*, pistil.

Eriocoma cuspidata Nutt. (Indian Millet).—A valuable grass of very wide distribution in the State. Pine Bluffs, July 5 (3606).

Muhlenbergia comata Benth. (Hairy Muhlenbergia).—A smooth perennial with rather scanty leaves, 1 to 2 feet high, heads spike-like, soft-hairy, the awns short and fine. Not plentiful; usually on river bottoms and most frequently among the stones on the low banks. Evanston, July 28 (3857); Grand Encampment Creek, August 13 (3994).

Muhlenbergia gracilis breviaristata Vasey.—Growing in tufted, mat-like clumps; leaves mostly radical, short; stems slender, 6 to 12 inches high; heads large for the size of the grass, awns very short. It occurs in the hills, mostly on the naked summits and ridges, sometimes in sufficient abundance to constitute an appreciable part of the forage. Head of Pole Creek, July 22 (3431).

Phleum alpinum L. (ALPINE TIMOTHY).—Very similar in general appearance to the ordinary field timothy, except that it is somewhat smaller. It is found on moist slopes and in the valleys at 8,000 to 11,000 feet, often constituting a large percentage of the most valuable forage. Beaver Basin, July 22 (3816); Battle Lake Mountain, August 17 (4050).

Alopecurus geniculatus fulvus Scribn. (MARSH FOXTAIL).—A succulent grass with an abundance of soft leaves, forming small, usually decumbent bunches, stems 12 to 20 inches long. It frequents wet ground, especially creek banks and shallow stream beds, where it forms tufts among the cobblestones. It is relished by stock, though it is probably rather watery in its composition. Little Laramie River, July 4 (3334); Willow Creek, July 13 (3379); Beaver Basin, July 22 (3812); Johnson's Ranch, August 9 (3908).

Alopecurus occidentalis Scribn. (MOUNTAIN FOXTAIL, fig. 5).—A valuable grass in the mountain meadows and parks. Battle Lake, August 16 (4017).

Sporobolus airoides Torr. (FINE-TOP SALT-GRASS, fig. 6).—This grass forms large mats or sometimes considerable areas of harsh, raised sod, the short, stiff root-leaves and wiry stems giving it a disagreeable feeling to the touch; 1 to 2 feet high, producing a large, widely spreading panicle. In spite of its stiffness, on the open bottom lands stock keep it well eaten down, and it is difficult to find fruited specimens. Little Laramie River, July 24 (3452); Pine Bluffs, July 7 (3619); Granger, July 30 (3877).

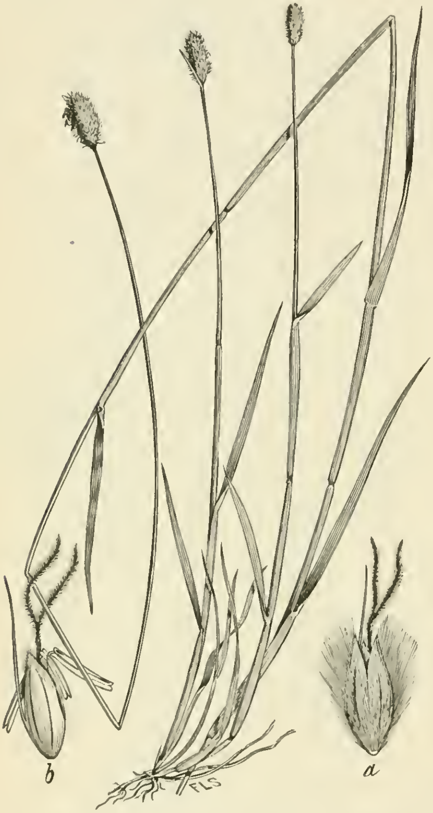


FIG. 5.—Mountain Foxtail (*Alopecurus occidentalis*): *a*, spikelet; *b*, floret.

Sporobolus asperifolius Thurb. (ROUGH-LEAFED SALT-GRASS, fig. 7).—Harsh but slender leaves and stems; 9 to 15 inches high, the numerous capillary pedicels of the panicle widely spreading. Probably of little value, though it may furnish some of the summer pasture on the bottom lands where it occupies the drier knolls, or more rarely is intermingled with other grasses on the lower, moist ground. Granger, July 30 (3876 and 3889).

Sporobolus confusus Vasey (fig. 8).—A small form growing in little tufts, the stems and leaves almost hairlike, and the delicate panicle widely spreading, 3 to 6 inches high. Not observed except on stony or gravelly stream banks, where it forms a scattering, inconspicuous growth. Laramie River, July 12 (3361); Grand Encampment Creek, August 13 (3990).

Sporobolus cryptandrus A. Gray (Sand Dropseed).—A tufted form with spreading stems, 12 to 18 inches long, occurring on sandy knolls and ridges; usually of very scattering growth, so that, though it is a nutritious pasture grass, it is of small economic importance. Hillsdale, July 7 (3660); Laramie, July 20 (3417).

Sporobolus depauperatus Scribn. (Dropseed).—Somewhat tufted, but still forming a continuous sod, stems and leaves slender, 6 to 12 inches high. A most excellent pasture grass. Centennial Valley, July 2 (3274); Evanston, July 27 (3841); Granger, July 30 (3883); Johnson's Ranch, August 8 (3901); Grand Encampment Creek, August 13 (4002); Wagon Hound Creek, August 21 (4403).

Sporobolus simplex Scribn.—A tiny alpine form, growing in little tufts, or sometimes as small patches of uniform sod; the fruiting heads slender and few-seeded; the fine root-leaves numerous and nearly as long as the capillary stems, which are 2 to 4 inches high. It occurs on the naked slopes in the vicinity of the permanent winter snow banks. Battle Lake Mountain, August 16 (4011).

Agrostis alba L. (Redtop, Herd's-grass).—This well-known grass occurs throughout the valleys of the whole region investigated. In many places it has no doubt been introduced, but in some of the localities where it was secured it must have been indigenous. It prefers wet ground, and thrives immensely under irrigation. In some of the valleys it is considered one of the important meadow grasses, as, for instance, at Evanston, in the Bear River Valley. Hillsdale, July 7 (3663); Evanston, July 27 (3832 and 4444); Granger, July 30 (3888); Grand Encampment Creek, August 13 (3995).

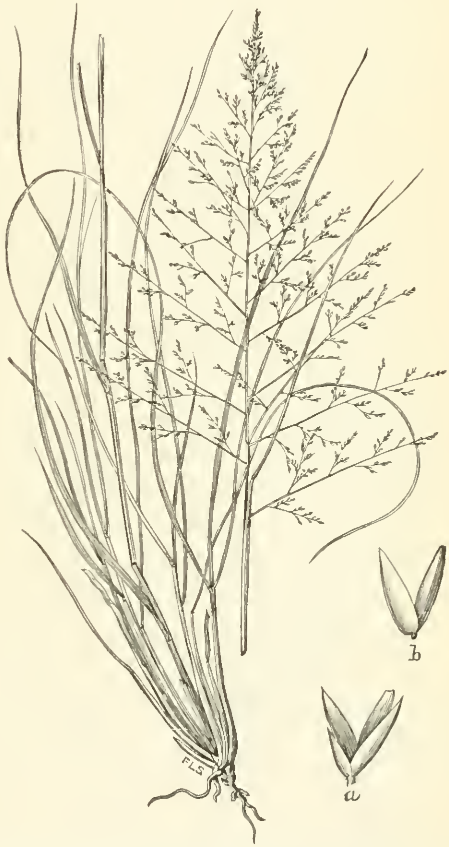


Fig. 6.—Fine-top Salt-grass (*Sporobolus airoides*): *a*, spikelet; *b*, floret.

Agrostis asperifolia Trin. (Rough-leafed Bent-grass).—An erect grass with long heads and numerous, ample leaves. It prefers wet ground, such as the banks of streams, partially shaded bottom lands, and more rarely boggy ground. It is a valuable constituent of the forage in such situations, and forms a part of the hay in wet meadows. Evanston, July 28 (3856); Woods Creek, August 9 (3964).

Agrostis scabra Willd. (Rough Hair-grass).—Erect, with slender leaves and stems and narrow, or, in older specimens, widely spreading panicle, the pedicels extremely long and hair like. It forms a small part of the native grasses on most of the bottom lands; occurring as scattering specimens or small clumps, most frequent in the loamy soil of stream banks, probably of little value, but on open grounds grazed down with the other grasses. Head of North Vermilion Creek, July 20 (3792); Evanston, July 28 (3851); Battle Lake, August 16 (4024).

Agrostis tenuis Vasey (Slender Hair-grass).—Resembling the preceding, but smaller, the panicle and its pedicels shorter and less spreading. Collected but once, in ground then fairly dry, but probably boggy earlier in the season. Low (6 to 12 inches high), and in small quantity. Battle Lake, August 16 (4014).

Agrostis humilis Vasey (fig. 9).—A bunch grass of very small proportion, only 3 to 5 inches high; seemingly very rare; only one small bunch secured on an alpine summit near a snowbank. Battle Lake Mountain, August 17 (4070).

Calamagrostis hyperborea americana Kearn. (Sand-grass; Yellowtop).—A tall fine-looking grass, with close cylindrical heads, often 3 to 4 feet high. In this range it seems to be found in abundance in wet draws and on banks where seepage water is abundant. It often forms a close, even growth, but as it requires so much water it can not be utilized, except on the wettest ground, as a meadow grass. Pine Bluffs, July 6 (3632); North Fork Vermilion Creek, July 19 (3772); Granger, July 30 (3884); Woods Landing, August 7 (3902); Medicine Bow River, August 21 (4089).

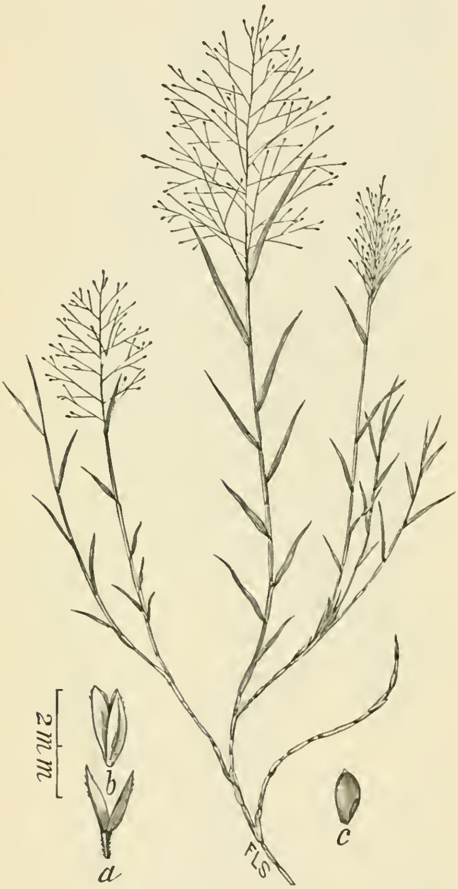


Fig. 7.—Rough-leafed Salt-grass (*Sporobolus asperifolius*): *a*, empty glumes; *b*, floret; *c*, caryopsis.

Calamagrostis canadensis (Mx.) Beauv. (Blue-joint grass).—Stems and leaves stouter than in the preceding, heads close and full, 2 to 3 feet high; infrequent, usually in wet places or on creek banks. Head of Pole Creek, July 22 (3437).

Calamagrostis canadensis acuminata Vasey (Mountain Blue-joint).—Much resembling the preceding in general appearance; in age the panicle is loose and spreading. It is the commoner form of this range, occurring both in open and in partially shaded ground. Its luxuriant growth and ample leaves suggests that it may be valuable under cultivation. In one mountain locality it formed a luxuriant and continuous growth among the fallen timber. Johnsons Ranch, August 9 (3905); Woods Creek, August 10 (3946); Battle Lake, August 16 (4018).

Calamagrostis montanensis Scribn. (Montana Blue-joint).—A small erect form, with close cylindrical heads, rarely more than a foot high. It occurs on dry or even on rocky slopes, and on the drier parts of the bottom lands as scattering specimens or irregular patches of various sizes. It must be considered as a pasture grass of some value. Horse Creek, July 13 (3381); Big Creek, August 11 (3970).

Calamagrostis purpurascens R. Br. (PURPLISH REED-GRASS, fig. 10).—A mountain form, 12 to 20 inches high, with ample root-leaves and close cylindrical heads. The specimens secured formed close bunches on the rocky cliffs and on the highest summits; not abundant. Battle Lake, August 16 (4047 and 4056).

Calamagrostis scribneri Beal (SCRIBNER'S REED-GRASS).—Erect and stout, with a wealth of long broad leaves and ample heads 3 to 4 feet high; the handsomest grass of the genus, often making a dense close growth that yields an abundance of hay, presumably excellent, though the leaves are somewhat scabrous to the touch. It prefers wet ground, but thrives on the bottom lands anywhere or even on the lower slopes of the adjacent hills. Johnsons Ranch, August 9 (3920); Woods Creek, August 10 (3954); Grand Encampment Creek, August 13 (3989); Medicine Bow River, August 20 (4082).

Calamovilfa longifolia Scribn. (BIG SAND-GRASS).—A coarse grass occurring in occasional clumps, 2 to 4 feet high. Rare in this range and probably confined to the eastern part of the State, where it occurs on the dry sandy plans or hillsides. Hillsdale, July 7 (3666).

Deschampsia caespitosa Beauv. (TUFTED HAIR-GRASS).—Densely tufted, with an abundance of long root leaves, the slender stems exceeding the leaves and terminating in large, loose, spreading panicles. It is of frequent occurrence throughout this entire range, occurring on all the streams, in the mountains on all the moist slopes, and even on alpine summits. Little Laramie River, July 4 (3337); Pine Bluffs, July 6 (3623); Beaver Basin, July 22 (3817); Evanston, July 28 (3860); Granger, July 30 (3890); Woods Landing, August 7 (3904); Battle Lake, August 16 (4008).

Trisetum subspicatum Beauv. (DOWNY OAT-GRASS).—Usually growing in small tufts, which are irregularly scattered on mountain slopes or more rarely in the valleys, root-leaves abundant, the upper stem nearly naked and bearing a short, cylindrical head, with soft, divergent awns. As a pasture grass it has value in proportion to its abundance. Battle Lake Mountain, August 17 (4045 and 4061).

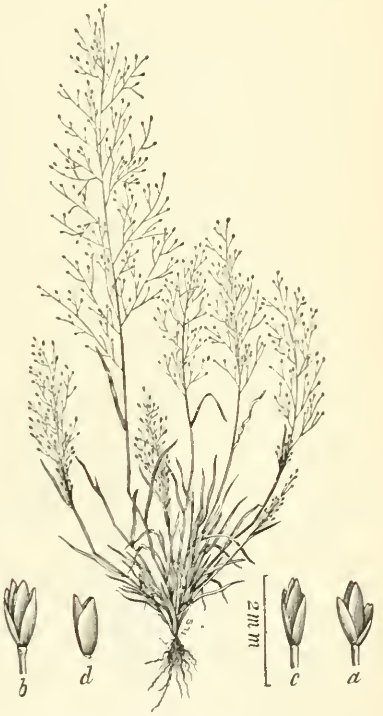


FIG. 8.—*Sporobolus confusus*: *a*, *b*, *c*, spikelets; *d*, floret.

Danthonia californica Boland. (CALIFORNIAN OAT-GRASS).—Decumbent at base and somewhat spreading or declined in habit, stems leafy, 20 to 30 inches high; panicle small. It is certainly very rare in the region, for which reason its forage value need not be taken into account. Observed but once as a scattering growth in an aspen grove in a moist valley. Greentop, June 29 (3253).

Danthonia intermedia Vasey (MOUNTAIN OAT-GRASS).—An erect, handsome grass with well-developed heads, 15 to 25 inches high. It occurs in small patches as an open sod in the margins of the woods or in the small parks in the mountains. In many places it is sufficiently abundant to have much value as a pasture grass. Battle Lake, August 17 (4037 and 4055); Woods Creek, August 9 (3959).

Danthonia parryi Scribn. (PARRY'S OAT-GRASS).—Somewhat similar to the preceding, but lower and with looser heads, more inclined to be tufted at base. This also is of rare occurrence, and is met with only in the hills so far as observed. Secured on open hillsides, where it occurred in small patches, growing on a soil of disintegrated granite. Greentop, June 29 (3245).

Spartina gracilis Trin. (SLENDER CORD-GRASS, fig. 11).—A perennial from tough underground root-stocks, rather rigid and woody, but not harsh; possibly of some value when young. It occurs as a scattering growth on sandy, alkaline soil on creek or pond banks. Laramie River, July 12 (3361); Pine Bluffs, July 6 (3630); Granger, July 30 (3885).

Schedonnardus paniculatus Trelease (FALSE CRAB-GRASS).—A worthless grass of spreading habit, leaves crowded at the base, the naked scabrous stems divaricately branched, rigid and brittle, at least when mature, 9 to 15 inches high. Of rare occurrence, usually in broken ground, such as dry ditches or plow furrows. Pine Bluffs, July 6 (3642).

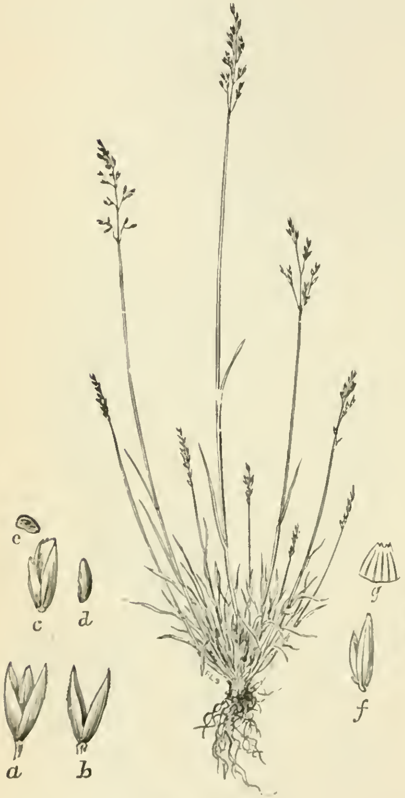


FIG. 9.—*Agrostis humilis*: *a*, spikelet; *b*, empty glumes; *c*, *f*, florets; *d*, palet; *e*, caryopsis; *g*, apex of flowering glume.

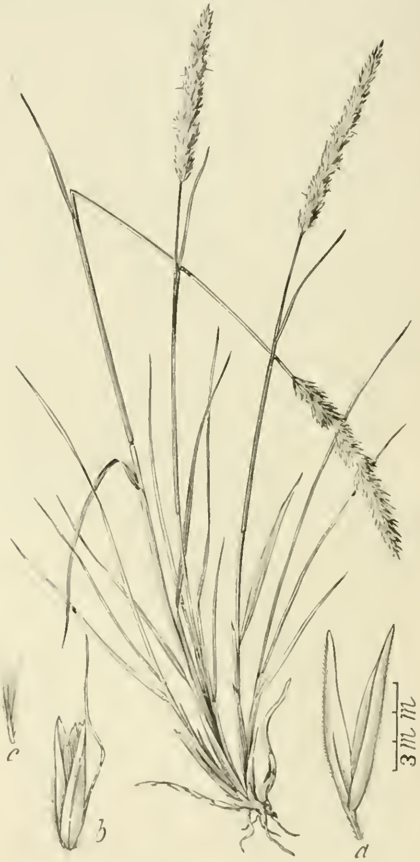


FIG. 10.—Purplish Reed-grass (*Calamagrostis purpurascens*): *a*, empty glumes; *b*, floret; *c*, prolongation of the rachilla.

Bouteloua oligostachya Torr. (BLACK GRAMA).—Somewhat tufted or matted, but often a fairly uniform growth over several rods of ground in a place, the numerous leaves are largely basal, the slender stems which bear the one sided heads, 10 to 18 inches high. This is preeminently the grass of the plains, occurring in greater or less abundance everywhere on the arid pasture lands. It is of especial value as a pasture grass, but furnishes a part of the hay on the drier second bottom meadows. It has the reputation of being very nutritious, and the condition of the stock pastured upon it bears out this idea fully. Laramie Plains, July 19 (3409); Pine Bluffs, July 6 (3619); Hillsdale, July 7 (3658); Woods Landing, August 7 (3909).

Beckmannia erucaeformis Host. (Slough-grass, fig. 12).—A grass of the bogs and of the margins of ponds and irrigation canals; erect, well leafed, heads long and slender, seeds flat and large, falling early and leaving the rachis bare almost as soon as it is mature. Probably of no special value, but in very wet ground it often constitutes a perceptible part of the plants that are cut for hay. Much of it, however, can not be utilized, as it grows in places where it is not accessible until so late in the season that it has lost its value for any purpose. North Fork Vermilion Creek, July 19 (3763); Evanston, July 27 (3834); Granger, July 30 (3881).

Bulbilis dactyloides Raf. (Buffalo grass).—Low and matted, ordinarily only a few inches high; staminate and pistillate heads on separate culms. Not nearly so common as is generally supposed, for much of what passes for this is generally one of the species of Grama grass. They are, however, readily enough distinguished, especially when they are headed out. On the open range these are all grazed down so closely that it becomes difficult to recognize them. This grass occurs on the open plains, but especially in flat draws among the ridges of hills that intersect the plains at intervals. It has no significance except as a pasture grass, and there seems to be some foundation for the belief that it is gradually disappearing from the range. Pine Bluffs, July 6 (3616).

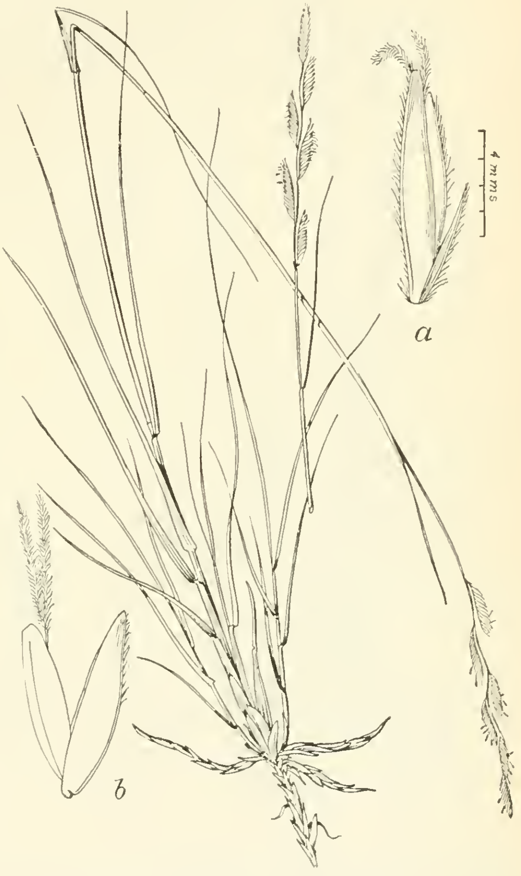


Fig. 11.—Slender Cord-grass (*Spartina gracilis*): *a*, spikelet; *b*, floret.

Eatonia obtusata Gray (Early Bunch-grass).—Soft, handsome, and well leafed, 18 inches to 3 feet high, with slender, close panicled heads. In moist ground, either open or partly shaded, it makes a most luxuriant growth. Certainly a good pasture grass, and in some meadows it is a valuable part of the hay crop. Granger, July 30 (3886); Grand Encampment Creek, August 13 (3993).

Koeleria cristata Pers. (Prairie June-grass).—Somewhat tufted, very leafy at the base; stems strict and erect, bearing a close cylindrical head, very variable in size, from a few inches to a foot or two in height. Perhaps the most generally distributed of our valuable pasture grasses, as it occurs in greater or less abundance on both plains and foothills, as well as to some extent in the mountains. It is quite variable, also, in appearance, depending no doubt largely upon the stage of development that it has reached and to some extent upon its habitat. Pine Bluffs, July 6 (3620); Beaver Basin, July 22 (3808); Evanston, July 28 (3850); Woods Landing, August 7 (3915); Battle Lake, August 16 (4040); Wagon Hound Creek, August 21 (4100).

Melica bulbosa Geyer (Bulbous Melic-grass, fig. 13).—A tall, handsome, grass, bearing small bulbs at the base of the straight stems; heads slender, but the spikelets plump; 2 to 3 feet high. An excellent grass, but usually of very scattering growth; often protected from stock by growing among the undershrubs on the banks of ravines. Not very widely distributed, in fact, observed only a few times in the foothills. Green Top, June 29 (3265); Sheep Mountain, July 3 (3306); Battle Lake, August 16 (4023).

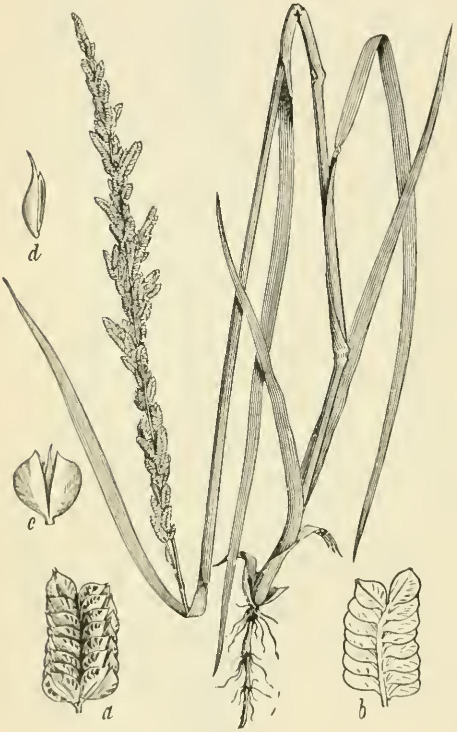


Fig. 12.—Slough-grass (*Beckmannia erucaeformis*): *a*, *b*, spike; *c*, spikelet; *d*, floret.

Distichlis spicata Greene (Salt-grass). — Leaves and stems somewhat slender, but rather stiff, from a few inches to a foot or more high. It is distinctively a grass of the alkaline flats, growing fairly well where salts are present in the soil to such an extent that other grasses can not live at all. It likes moisture, but is not absent from comparatively dry ground. The sod it forms is often close, but always harsh and disagreeable. In the desert regions it is valuable for the pasture it furnishes about the springs that serve as watering places for the stock on the open range. Pine Bluffs, July 6 (3631).

Poa arctica R. Brown (Arctic Spear-grass). — A densely-tufted grass, with erect stems and very lax heads, the slender pedicels loosely spreading. It seems to be a valuable pasture grass, but occurs mostly at high elevations, so as not to come within the ordinary range of stock; it prefers moist, rich slopes or creek bottoms, and attains in such places a height of 15 to 25 inches. Head of Pole Creek, July 22 (3432).

Poa arida Vasey (Bench-land Spear-grass, fig. 11).—Forming small bunches, the root leaves short but abundant, the stems slender and almost naked above, 10 to 18 inches high. Valuable as an early pasture grass on the drier bench lands, but of little value in the meadows, for it is past its prime before the other grasses are ready to be harvested. Pine Bluffs, July 6 (3613); Granger, July 30 (3887).

Poa buckleyana Nash (Bunch-grass).—A bunch-grass with erect, slender stems, 15 to 25 inches high; root leaves abundant but short. One of the most widely distributed and valuable of the pasture grasses, but greatly variable in size and appearance in different situations. Its time of development and maturity varies with the character and moisture of the soil and the altitude, so that in different localities it will be found in excellent condition throughout the season. Green Top, June 29 (3244); North Fork Vermilion Creek, July 20 (3780); Head of Vermilion Creek, July 20 (3798); Battle Lake, August 17 (4043).

Poa epilis Scribn.—Very slender stems, 12 to 18 inches high, with short, rather broad heads; root leaves small and stem nearly naked. It was met with only once at an almost alpine height, growing as scattering specimens among the broken, granite rocks. Battle Lake Mountain, August 17 (4067).

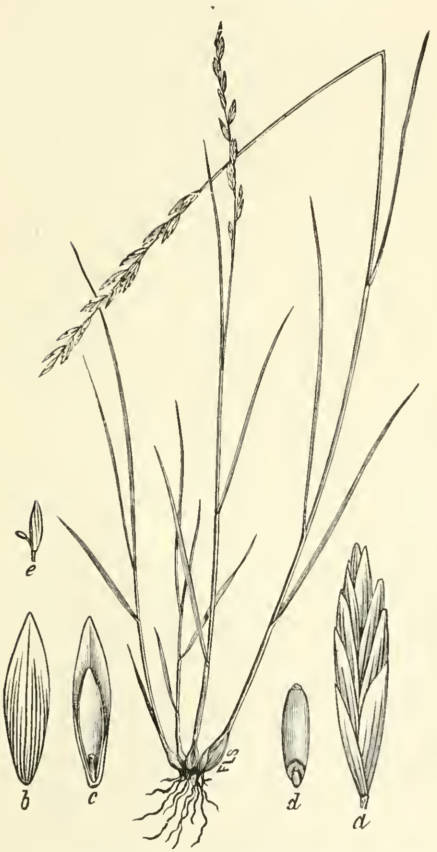


FIG. 13.—Bulbous Melic-grass (*Melica bulbosa*): *a*, spikelet; *b*, flowering glume; *c*, floret; *d*, caryopsis; *e*, terminal rudimentary floret.

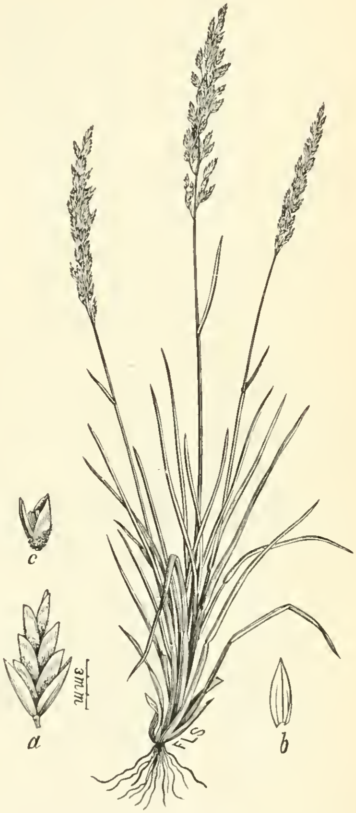


FIG. 14. — Bench-land Spear-grass (*Poa arida*): *a*, spikelet; *b*, flowering glume; *c*, floret.

Poa fendleriana Vasey (FENDLER'S SPEAR-GRASS).—A small bunch-grass, 10 to 15 inches high, with numerous leaves and ample panicles. It occurs on rocky slopes in the foothills in the western part of the State; seemingly neither frequent nor abundant, but undoubtedly an excellent pasture grass. Evanston, May 29 (2970, 2986, and 2998).

Poa flava L. (FALSE REDTOP).—Tall and slender, 2 to 3 feet high, with long, spreading panicles. In some localities a conspicuous grass in the wet draws on bottom lands at least, so in inclosures where it is allowed to head out. In open ground and in pastures, stock graze it down closely, indicating that it is among the most relished of pasture grasses; of considerable importance in localities near Evanston and Medicine Bow River. Evanston, July 27 (3818 and 3858); Medicine Bow River, August 21 (4093).

Poa glauca Vahl. (Spear grass).—This smooth, handsome bunch-grass occurs sparingly in the mountains. It prefers moist places, where, under favorable conditions, it will attain a height of 12 to 18 inches. It is an excellent pasture grass, as evidenced by the extent to which it is sought out by stock. Head of Pole Creek, June 19 (3196).

Poa laevigata Scribn. (Smooth Bunch-grass).—A bunch-grass of much value, 1 to 2 feet high. It has adapted itself to very diverse conditions, as shown by its being found in all kinds of soil—on the strongly alkaline of the Bitter Creek flats to that of the open mountain parks; on moist creek banks and dry hillsides and ridges. It develops early, hence is of much value as early summer pasture. North Vermilion Creek, July 19 (3766); Colorado-Wyoming line, July 22 (3807); Evanston, July 27 (3837); Granger, July 30 (3891).

Poa leptocoma Trin.—A rare grass of scattering growth, the stems weak and the leaves soft and broad; observed but once as scattering, individual specimens on the broken banks of a streamlet in a subalpine park. Battle Lake, August 16 (4019).

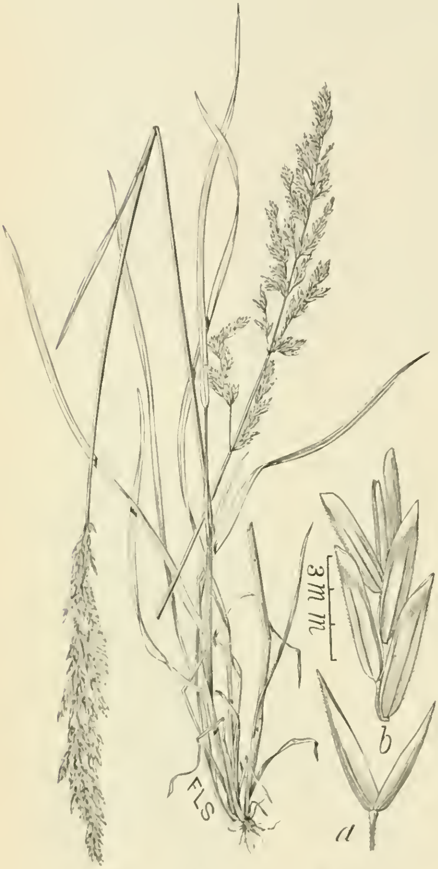


Fig. 15.—Nevada Blue-grass (*Poa nevadensis*): *a*, empty glumes; *b*, florets.

Poa longepedunculata Scribn. (Long-stalked Bunch grass).—A remarkably fine bunch-grass, the tufts large and close, 20 to 30 inches high; leaves short and largely basal, the numerous naked stems slender and erect; panicle ample but close. It is a grass of the hill regions, occupying the slopes and summits, often in considerable abundance. Sheep Mountain, July 3 (3292).

Poa lucida Vasey (Shining Bunch-grass).—A widely distributed grass, but never greatly abundant; erect in habit, with long ample leaves; of excellent quality, and adapting itself to various habitats. Green Top, June 29 (3257; Laramie River, July 20 (3115); Woods Landing, August 7 (3906).

Poa nemoralis L. (Wood Meadow-grass).—Growing in bunches, leaves and stems slender, the panicle ample, loose and spreading; an excellent grass, attaining a height of 2 feet or more. It occurs in partly wooded areas, on the slopes or on the creek banks, where it is often a very important part of the forage. Head of Vermilion Creek, July 20 (3791); Grand Encampment Creek, August 13 (3983).

Poa nemoralis L. var ?.—Much smaller than the preceding, with perfectly erect stems; the heads a shorter, closer panicle. Probably a form of higher altitudes. Head of Pole Creek, July 22, (3435).

Poa nevadensis Vasey (Nevada Blue-grass, fig. 15).—Forming small bunches, the ample leaves, numerous stems, and well-developed heads make this a grass that always attracts attention. In the open range it is always browsed down except where protected by fallen timber or otherwise. It seems to prefer open woods on the slopes of the foothills or, more rarely, the partly shaded stream banks. Laramie Hills, June 16 (3179); "G." Summer ranch, July 23 (3823); Granger, July 30, (3891*a*).

Poa pratensis L. (Kentucky Blue-grass, fig. 16).—This well-known grass needs no description. It is widely distributed and everywhere recognized as a most important grass. Centennial Valley, July 2 (3278); North Vermilion Creek, July 18 (3758); head of North Vermilion Creek, July 20 (3796); Evanston, July 27 (3844); Woods Creek, August 9 (3942; Grand Encampment, August 13 (3999).

Poa reflexa Vasey & Scribn. (Mountain Blue-grass). — A beautiful form of the higher mountains, usually as a bunch grass but often more scattering; stems moderately slender, 10 to 18 inches high; panicle loose and ample, the pedicels reflexed in age. It occurs in ravines and sometimes in abundance on the slopes in subalpine stations. That it is an excellent pasture grass hardly admits of doubt, but it is too often in most inaccessible places. Battle Lake Mountain, August 17 (4038 and 4044).

Poa sheldoni Vasey (Sheldon's Blue-grass, Pl. IV).—Stems slender and erect with well-formed heads; leaves mostly basal, short, slender, and somewhat rigid; usually occurring as a bunch grass, varying in height from 1 to 2 feet, according to location. It probably belongs to the arid region, but is not confined to the drier situations. In fact, it occurs more frequently on the drier portions of the bottom lands and on the higher ground about spring bogs. In all such situations it must be considered as one of the valuable grasses. Its earliness detracts from its value as a meadow grass unless it can be grown by itself, as it is out of condition before the other constituents of the meadow are in condition for harvesting. Pine Bluffs, July 7 (3644); Beaver Basin, July 22 (3806); North Fork, Vermilion Creek, July 18 (3754 and 3785); Evanston, July 28 (3869).

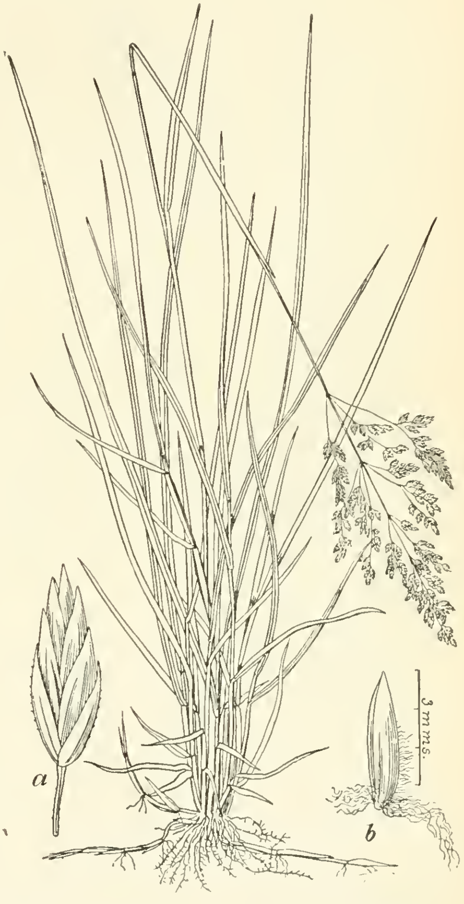


Fig. 16.—Kentucky Blue-grass (*Poa pratensis*): *a*, spikelet; *b*, floret.

Poa wheeleri Vasey (Wyoming Blue-grass, fig. 17).—Slender stemmed; 10 to 24 inches high; basal leaves numerous; panicles close or looser in age. This bunch grass is valuable as pasture, but, like the preceding, would be more so if it oftener descended into the lower altitudes of the foot hills or the plains. Centennial Valley, July 2 (3290); Battle Lake, August 17 (4049).

Graphephorum muticum Scribn. (?).—A handsome grass, with broad green leaves; rather large stems, 2 to 3 feet high; head a close, nearly cylindrical panicle, 3 to 6 inches long. Probably very rare; secured but once. Battle Lake, August 16 (4012 and 4013).

Panicularia americana MacM. (Reed Meadow-grass; Tall Manna-grass).—Stems stout, 2 to 4 feet high; leaves large and abundant; the panicle ample, loose, and spreading, 6 to 12 inches long. This very handsome grass thrives on wet bottom lands and in the shallow sloughs that border our streams. Its forage value is much underestimated, for not only can immense crops of it be produced, but the quality of the hay is far above the average ordinarily secured from wet lands. Evanston, July 24 (3871); Woods Landing, August 7 (3907).

Panicularia borealis Nash (Northern Meadow-grass).—Stem weak, moderately leafy, 2 to several feet in length, sometimes rooting at the nodes in the mud at the bottoms of the ponds in which it grows; panicle very long and open, soon naked through the early disintegration of its spikelets. Of no economic importance, for it occurs, so far as my observation goes, only as scattering specimens in deep, clear, fresh-water ponds. Johnson's ranch, August 8 (3936); Grand Encampment, August 13 (3986).

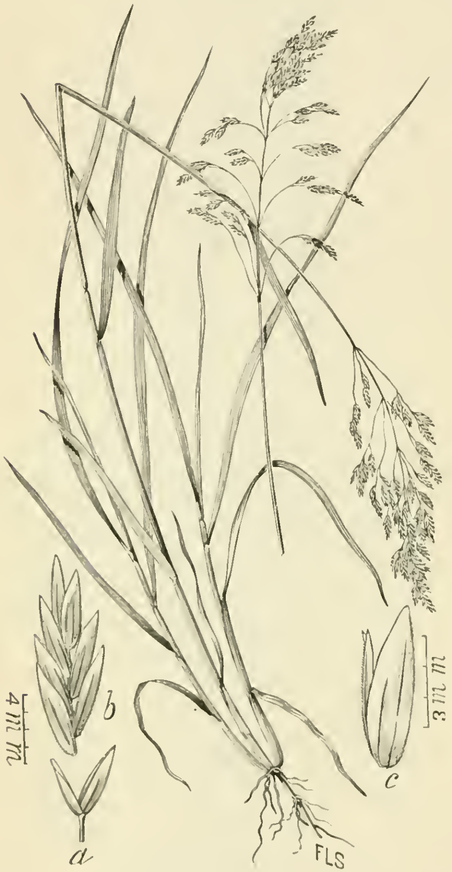


Fig. 17.—Wyoming Blue grass (*Poa wheeleri*): *a*, empty glumes; *b*, *c*, florets.

Panicularia nervata Kuntze (Nerved Manna-grass, fig. 18).—Soft, succulent leaves and stems, rather weak, 2 to 3 feet high; usually as a scattering growth in partly shaded bottom lands, but sometimes in considerable abundance in wet open meadows. It is greedily eaten by stock, but as a hay grass it probably lacks weight and substance. North Vermilion Creek, July 19 (3769); Woods Creek, August 9 (3955); Cooper Hill, August 22 (1405).

Panicularia nervata stricta Scribn.—Similar to the preceding, but smaller. Of small economic importance, as it occurs only as scattering specimens in the broken soil of the creek banks. Colorado-Wyoming line, July 22 (3818); Grand Encampment Creek, August 13 (3979).

Puccinellia airoides Wats. & Coult. (ALKALI MEADOW-GRASS).—Erect, with slender, tufted stems, 1 to 2 feet high, the panicle long, open, and spreading; a grass of the wet, saline flats and the ditch banks. Laramie River, July 4 (3332); Hillsdale, July 7 (3664).

Festuca brevifolia R. Brown (SHORT-LEAFED FESCUE).—Closely tufted, with numerous short basal leaves; stems strict, 6 to to 10 inches high, the panicle close and slender; infrequent, occurring on the dry ridges of disintegrated granite. Head of Pole Creek, July 22 (3430).

Festuca elatior pratensis Scribn. (MEADOW FESCUE).—Slender, weak stemmed, 2 to 3 feet high; a few scattering specimens secured on Crow Creek. Cheyenne, July 8 (3664*a*).

Festuca thurberi Vasey (THURBER'S FESCUE). — A handsome Poa-like plant, forming large compact sods on the edge of the thickets along the mountain streams; leaves and stems slender, 2 to 3 feet high; inclined to be harsh to the touch, so that when mature probably not very well relished by stock. Willow Creek, July 13 (3377).

Festuca kingii Scribn. (KING'S FESCUE, fig. 19).—Thick-stemmed, 1 to 2 feet high; leaves few, short, and broad; the bases of the stems sheathed by the old leaves. This is a grass of the sandy or gravelly slopes and banks in the foothills, probably never forming a continuous sod, but sometimes abundant enough to be of importance as a pasture grass. Evanston, May 29 (2995); Sheep Mountain, July 3 (3300); "G." Summer ranch, July 23 (3826).

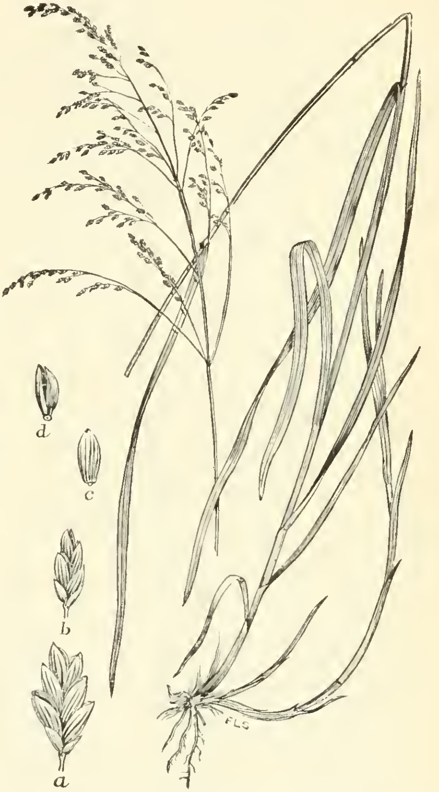


FIG. 18.—Nerved Manna-grass (*Panicularia nervata*): *a*, *b*, spikelets; *c*, *d*, florets.

Festuca ovina L. (SHEEP'S FESCUE).—Densely tufted, the slender leaves and stems very numerous, 6 to 18 inches high; panicle slender, the spikelets being closely appressed; awns short but noticeable; widely distributed and often abundant, especially on dry ridges and disintegrated granite slopes. Head of Pole Creek, June 19 (3195); Green Top, June 29 (3242); Sheep Mountain, July 3 (3303); Battle Lake Mountain, August 17 (4062).

Festuca rubra L. (RED FESCUE).—Somewhat resembling the preceding, but in smaller tufts or as single specimens, stems seemingly longer and more slender. Not plentiful in this range. Colorado-Wyoming line, July 22 (3819).

Bromus breviaristatus Buckl. (SHORT-AWNED BROME-GRASS).—A fine appearing grass, 2 to 4 feet high; stems erect, leaves large and numerous, the panicle long with closely appressed or at least ascending branches. It occurs in open woods in the mountains where it sometimes forms meadow-like tracts of considerable extent. It seems to be relished by all kinds of stock, and it was noted that on Pine Mountain, where it is very abundant, sheep, being grazed there in July, were feeding upon it very freely. In high mountain meadows it would prove very valuable as a hay grass. Horse Creek, July 10 (3358). Little Laramie River, July 4 (3333); Medicine Bow River, August 20 (4073).

Bromus ciliatus scariosus Scribn.—A small form only 12 to 18 inches high: leaves slender and stems weak; panicle short and spreading, the spikelets on slender pedicels. Rare, secured but once, in a dry, stony canyon on the side of a mountain where scattering specimens occurred at intervals. Sheep Mountain, July 3 (3305).

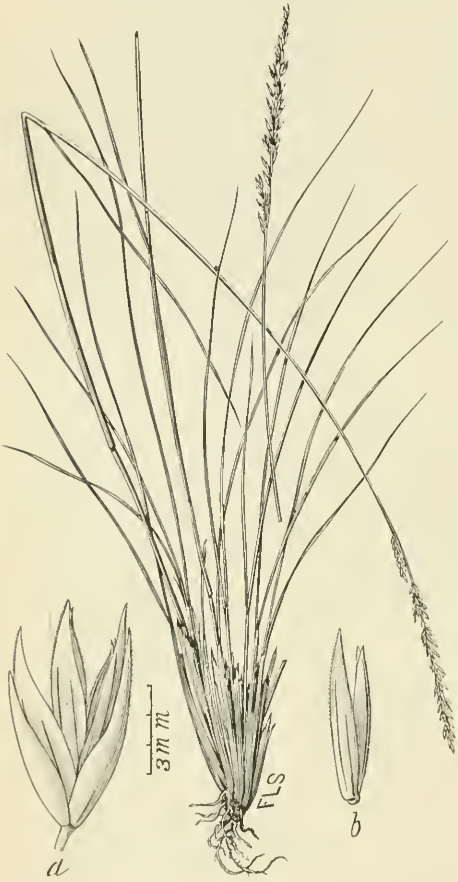


Fig. 19.—King's Fescue (*Festuca kingii*): *a*, spikelet; *b*, floret.

Bromus kalmii Gray (Kalm's Chess). —Leaves abundant, stems erect, 2 to 3 feet high; panicles many-flowered, often drooping, the pedicels slender and flexuous. This bunch grass is a very important one in some of the mountain ranges. In open woods on stony hillsides it occurs in great abundance, as it frequently does in some of the higher-lying meadows. Woods Creek, August 9 (3948); Medicine Bow River, August 22 (4083).

Bromus multiflorus Scribn. (Large Mountain Bromegrass).—Erect, moderately strong stemmed, 3 to 4 feet high, leaves large and numerous; panicles ample, close, many flowered, the spikelets erect or nearly so, awns short but evident. For further notes upon this grass, which undoubtedly has great economic value (see page 29). "G." Summer ranch, July 23 (3827); Battle Lake, August 16 (4021 and 4035); Pine Mountain, head of Vermilion Creek, July 18 (3759).

Bromus porteri (Coult.) Nash (Porter's Chess).—Erect, with ample leaves, 2 to 3 feet high; panicle long, its branches lax and spikelets on slender flexuous pedicels. Undoubtedly a valuable grass, but usually only scattering, individual specimens in the aspen copses or on the more open hillsides. Battle Lake, August 16 (4022); Cooper Hill, August 22 (4107).

Bromus scabratus Scribn. (Scabrous Chess).—Harshly scabrous, leaves and stems slender, somewhat flexuous, 2 to 3 feet long; panicle open, spikelets very slender, on filiform flexuous pedicels. My field notes say "A very common grass on the creek bottoms at this station. It forms a portion of the general growth over all the district observed. Apparently not browsed down so fully as some of the other grasses even where stock has full access to it." Head of Vermilion Creek, July 20 (3800).

Agropyron caninoides Beal. (Bearded Wheat-grass).—This wheat-grass occurs mostly as a bunch grass; the bunches small with stoutish, erect stems; heads long, close, and well awned. It probably is rare, though it was found in fair quantity on the borders of a mountain brook and extending well up on the adjacent hillsides. Woods Creek, August 9 (3940).

Agropyron caninum R. & S. (Bearded Wheat grass).—Somewhat resembling the preceding but smaller, with shorter leaves. Probably of the plains rather than the mountains. Laramie River, July 31 (3458).

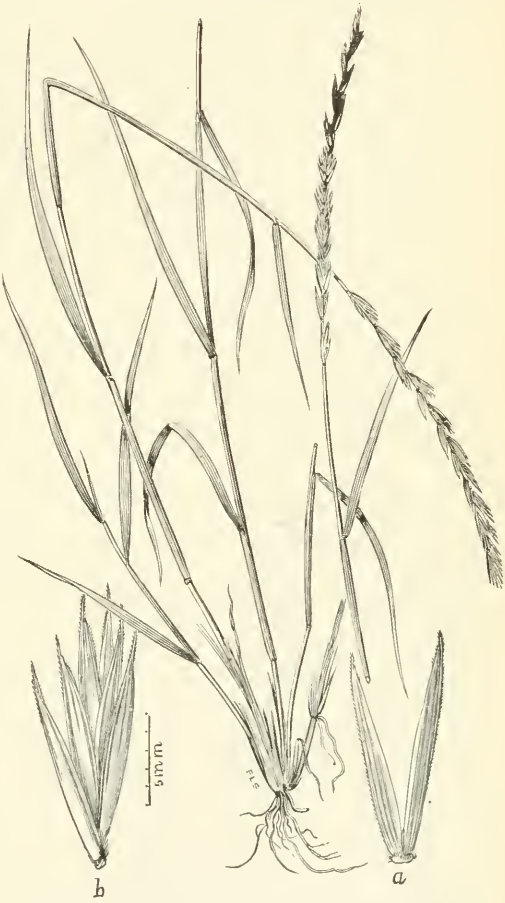


Fig. 20.—False Couch-grass (*Agropyron pseudorepens*): *a*, empty glumes; *b*, florets.

Agropyron dasystachyum subvillosum S. & S.—It is especially valuable upon saline lands and responds with an increased yield to more favorable situations. Pine Bluffs, July 5 (3604); Colorado-Wyoming line, July 22 (3804); Evanston, July 27 (3836).

Agropyron divergens Nees. (Bunch Wheat-grass).—A bunch grass, the stems and leaves densely tufted, 18 to 30 inches high; heads long, narrowly spike-like, with long, divergent, twisted awns. Common in the foothills on dry, stony ridges and slopes. Readily eaten by stock, especially before the awns have developed and after they have fallen off. Laramie Hills, June 16 (3181); Green Top, June 29 (3243); Sheep Mountain, July 3 (3298).

Agropyron pseudorepens S. & S. (False Couch-grass, fig. 20). — Forming dense bunches, the numerous stems stout, erect as a whole, but somewhat bent at base, spikes 4 to 6 inches long, awns short. Pronounced a most excellent grass for hay purposes, both on account of its quality and its heavy yield. It would seem that some of the other wheat-grasses that form a uniform sod could be used to better advantage than this bunch-grass on grounds which are to be seeded to permanent meadow. Pine Bluffs, July 6 (3634); Woods Creek, August 9 (3965); Battle Lake, August 17 (4064).

Agropyron richardsoni Schrad. (Richardson's Wheat-grass).—In a general way resembling the preceding, but growing mostly as scattering, individual specimens; the spikes conspicuously awned. It occurs mostly on the edges of clearings or in open woods. Hardly abundant enough to have much significance in this range. Woods Landing, August 7 (3923); Grand Encampment, August 13 (3978); Cooper Hill, August 22 (4408).

Agropyron riparium S. & S. (BANK WHEAT-GRASS).—Stems slender, erect, 2 to 3 feet high; leaves sparse, mostly basal; spike narrow, spikelets rather distant, giving an interrupted appearance. Occurring both on the saline soil of the plains and the alluvial soil of mountain parks. In the latter situations it often forms meadow-like tracts, indicating that under cultivation it may prove a valuable member of this important genus of grasses. Little Laramie River, July 24 (3447); Colorado-Wyoming line, July 22 (3813).

Agropyron spicatum S. & S. (WESTERN WHEAT-GRASS).—An erect, rather coarse species with large heads of conspicuous spikelets. It grows as a continuous but open sod and yields a large amount of valuable forage. Pine Bluffs, July 6 (3610); Evanston, July 27 (3847); Granger, July 30 (3878); Grand Encampment, August 13 (3997).

Agropyron spicatum molle S. & S.—Very similar to the preceding but smaller; confined in this range almost wholly to saline regions, where it is of much importance. Sheep Mountain, July 3 (3299).

Agropyron tenerum Vasey (SLENDER WHEAT-GRASS).—Leaves numerous, stems slender and erect; spikes 3 to 6 inches long, the few flowered spikelets closely appressed, awns very short. As previously stated, this seems to be the most valuable of the wheat-grasses for this range. Pine Bluffs, July 6 (3628); North Vermilion Creek, July 19 (3773); Evanston, July 27 (3846); Granger, July 30 (3880); Grand Encampment, August 13 (3976); Medicine Bow River, August 20 (4076).

Agropyron tenerum ciliatum S. & S.—Smaller, more slender, spikelets less crowded. A valuable grass, but not widely distributed. North Vermilion Creek, July 18 (3755).

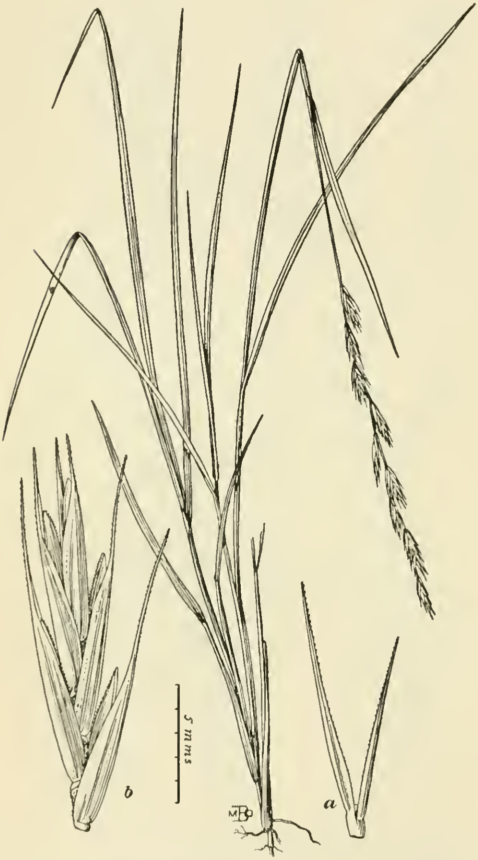


FIG. 21.—*Elymus simplex:* a, empty glumes; b, florets.

Agropyron vaseyi S. & S. (VASEY'S WHEAT-GRASS).—In habit and general appearance much resembling *A. divergens.* Like that, it occupies dry slopes and the summits of hills, this especially in the "red formations" of the desert. Pine Mountain, head of Vermilion Creek, July 20 (3797).

Agropyron violaceum Vasey (MOUNTAIN WHEAT-GRASS).—Stems, stout, short, 10 to 18 inches high, spikes slender, purplish. A grass of much value and wide distribution, in this range rather rare and confined to the hill country. Laramie Hills, July 17 (3103).

Triticum aestivum L. (WHEAT).—Some specimens found in an old stock yard. Grand Encampment Creek, August 13 (3984).

Hordeum jubatum L. (SQUIRREL-TAIL GRASS).—More or less abundant throughout this entire range.

Hordeum occidentae Scribn.—Slender stemmed, 12 to 18 inches high; leaves abundant; spikes slender, with awns of moderate length. It forms a uniform growth but rather open sod, in which it differs from the preceding, which is usually found in tufts or bunches. This would have forage value of no mean degree except for the awns, which are said to make it objectionable. North Vermilion Creek, July 20 (3781).

Hordeum nodosum L. (MEADOW BARLEY).—Wagon Hound Creek, August 21 (4099).

Elymus ambiguus V. & S.—Slender, rather rigid leaves and stems, 12 to 18 inches high; spike narrow, 3 to 6 inches long, inclined to have an interrupted appearance; awns very short. Neither common nor abundant, collected but once, on the alkali flats bordering the banks of Hams Fork. Granger, September 1 (4451).

Elymus canadensis L. (WILD RYE).—Tall and somewhat coarse, 3 to 5 feet; stems leafy; spikes dense, 4 to 8 inches long, bearded. This well-known bunch grass is confined to the drier regions of the eastern part of the State, where it is of frequent occurrence and often abundant. Pine Bluffs, July 6 (3637).

Elymus condensatus Presl. (GIANT RYE-GRASS).—A tall, smooth, coarse grass forming immense clumps. The most conspicuous grass throughout the entire southwestern part of the State. North Vermilion Creek, July 23 (3829).

Elymus glaucus Buckl.—This rye grass seems to belong to the wooded areas, occurring as scattering specimens or in small bunches in aspen thickets or among the fallen timber on wooded slopes. Battle Lake, August 16 (4016); Medicine Bow River, August 21 (4085); Cooper Hill, August 21 (4413).

Elymus macounii Vasey.—A bunch grass of much promise; my field notes make special mention of its abundance of soft, excellent leaves. It rarely occurs as an open, continuous sod on bottom lands or in the draws among the hills. Pine Bluffs, July 6 (3624); North Vermilion Creek, July 20 (3783).

Elymus occidentalis Scribn. (WESTERN RYE-GRASS).—Tall and slender stemmed, 3 to 4 feet; spikes short, pubescent, awns of moderate length. Probably rare, only one small patch of it observed; on the dry terraces separating the first and second bottom lands. Laramie River, September 15 (4470).

Elymus simplex Scribn. (fig. 21).—A stiff, harsh perennial, 1 to 2 feet high; spikes slender, inclined to appear interrupted, 3 to 5 inches long. But little of it observed, and that growing in small bunches on the grassy banks of an irrigating canal. Little Laramie River, July 4 (3335).

Sitanion elymoides Raf. (LONG-BEARDED WILD RYE.)—This bunch grass differs much in appearance and size in different habitats. On the dry saline plains of the desert it forms low, compact bunches and the spikes have awns of moderate length; on moist mountain slopes the bunches are loose, the stems long and spreading, the spikes loose, and the divaricate awns of inordinate length. In any case it can not be looked upon with any favor as a forage plant. Pine Bluffs, July 6 (3608); North Vermilion Creek, July 20 (3784); Woods Creek, August 9 (3952).

SEDGES.

Eleocharis palustris (L.) R. & S. (COMMON SPIKE-RUSH.)—Slender stemmed and of very close compact growth, 10 to 15 inches high. This species occurs in very many boggy places as a pure growth and in over-irrigated meadows it often constitutes a large percentage of the crop that is put up and labelled hay. Some forage value it no doubt has, but it is to be regretted that the better true grasses should be drowned out only to be replaced by this. Centennial Valley, July 4 (3329); Pine Bluffs, July 7 (3656); North Vermilion Creek, July 19 (3764); Evanston, July 27 (3833).

Eleocharis sp. (?).—Erect and close growing, the stems slender, 5 to 8 inches high; spike short, oblong. Common on the marshy banks of the streams and ponds. Pine Bluffs, May 15 (2899).

Scirpus campestris Britt. (PRAIRIE RUSH).—Stems triangular, stout and very leafy, 1 to 2 feet high; leaves broadly linear, flat, nearly equalling the stems; perennial from tubers borne at the end of short horizontal rootstocks, the annual stems arising from the previous year's tubers. The species seems able to endure any amount of alkali, as it was found in dry alkali-lake beds where no other vegetation seemed able to exist. Granger, July 30 (3874); Laramie, August 30 (4462).

Scirpus americanus Pers. (AMERICAN RUSH).—Long, rather slender triangular stems; spikelets small, clustered capitate, overtopped by the single involucral leaf. A common rush in most of the bogs of the region, but especially so in the saline bogs and marshes adjacent to Bitter Creek, in the desert. Pine Bluffs, July 7 (3650); Laramie, August 30 (4468).

Scirpus lacustris L. (GREAT BULRUSH).—Stems stout, cylindrical, smooth, and erect, spikelets umbellately clustered. Rarely wholly absent from fresh-water bogs throughout this range. Pine Bluffs, July 7 (3651); North Vermilion Creek, July 17 (3767).

Scirpus microcarpus Presl. (SMALL-FRUITED BULRUSH).—Erect, 3 to 4 feet high; leaves abundant and large; spikelets very numerous in an open infloresence which approaches a compound umbel. This species prefers fresh-water ponds or the banks of slow flowing streams. It occurs in some abundance in many of the wetter meadows, where it constitutes a perceptible part of the hay product. Woods Landing, August 7, (3911): Grand Encampment, August 13 (4078).

Carex acuta tenuior Bailey.—A species of sedge with very slender leaves and stems, 9 to 15 inches high, growing in almost unbreakable clumps on the margins of lakes and ponds. Infrequent; Battle Lake, August 16 (4039).

Carex athrostachya Olney.—A slender stemmed sedge producing an abundance of excellent leaves, a valuable ingredient in many wet meadows. Centennial Valley, July 2 (3280); Wood's Landing, Big Laramie River, August 7 (3898); Grand Encampment, August 13 (4000); Medicine Bow River, August 21 (4092).

Carex atrata L. (BLACK SEDGE).—Another sedge with long, slender stems and numerous broad root-leaves about half the length of the stem. It forms only a scattering growth among the rocky ledges in subalpine regions. Battle Lake Mountain, August 17 (4065).

Carex aurea Nutt. (GOLEN-FRUITED SEDGE).—A small form, from a few to several inches in height, flexuous stems and flat, light-green leaves, occurring about springs and in wet meadows, but rarely in sufficient amount to have any economic significance. Evanston, July 28 (3854).

Carex deflexa media Bailey (NORTHERN SEDGE).—This forms close mats, sometimes of great size; the leaves are especially numerous, and though it rarely exceeds 6 inches in height it has the appearance of being one of the best pasture grasses of the higher slopes and ridges in our mountains. Battle Lake Mountain, August 17 (4016).

Carex douglasii Boott (DOUGLAS'S SEDGE).—A low caespitose form that develops early, usualy only a few inches high, but at maturity as much as a foot high in some localities. The heads are large and the leaves of excellent quality. It is an important part of the pasture in some of the localities investigated. Evanston, May 29 (3017); Laramie River, June 18 (3188); Centennial Valley, July 3 (3288); Wagon Hound Creek, August 21 (4102).

Carex festiva stricta Bailey.—This fine looking sedge prefers wet places, especially pond and creek banks. It produces an abundance of excellent leaves and is no doubt readily eaten by stock. As an admixture in wet meadows it would be of value. Green Top, June 29 (3255); Head of Vermilion Creek, July 20 (3701); Evanston, July 28 (3862).

Carex festiva viridis Bailey.—Somewhat resembling the preceeding, but larger and more leafy; bright green; seemingly it is a form belonging to the higher mountains. Battle Lake, August 16 (4012).

Carex filifolia Nutt. (THREAD-LEAFED SEDGE).—A densely tufted form with very slender stems and leaves, somewhat stiff, and only a few inches high; not common, occurring on dry ridges and plains in the eastern part of the State, where it undoubtedly forms a part of the early summer range pasture. Pine Bluffs, May 15 (2895).

Carex geyeri Boott (GEYER'S SEDGE).—A very leafy form, 6 to 9 inches high, rare and scattering, only a few specimens found among the broken, granite rock at subalpine heights. Battle Lake Mountain, August 17 (4063).

Carex hoodii Boott (HOOD'S SEDGE).—Stems long and slender; an abundance of fine leaves. It has the appearance of being a good forage plant, but it is not abundant. As it is a bunch sedge and belongs to high mountain regions it is doubtful whether any use can be made of it under cultivation. Battle Lake, August 16 (4033).

Carex jonesii Bailey (JONES'S SEDGE).—A sedge of the mountain swamps, scattering in growth, 2 feet or more in height. Battle Lake, August 16 (4015).

Carex lanuginosa Michx. (WOOLLY SEDGE).—This slender-stemmed sedge, with its wealth of long, fine leaves, seems to the writer to be the most desirable of the sedges for hay purposes. While it abounds in swamps, yet it will grow where the soil is simply wet. It forms a very dense growth, and it seems that in meadows too wet for the better grasses or where natural flooding occurs that this may be worthy of introduction. Pine Bluffs, July 7 (3653); north fork Vermilion Creek, July 19 (3768); Evanston, July 27 (3831); Granger, July 30 (3882); Grand Encampment, August 13 (3988).

Carex marcida Boott. (CLUSTERED FIELD-SEDGE).—Perennial from horizontal rootstocks, from which arise numerous stems, 12 to 20 inches high, from the lower part of which spring numerous narrow leaves somewhat shorter than the stems. This is one of the most valuable sedges that was found in the native meadows. It thrives in wet ground, but will also do well on comparatively dry ground. It usually is found as an admixture with other forage plants, but in a few instances it was found as a pure growth on the drier ground of the bottom lands. It is considered valuable as a hay crop, and the writer knows that it is closely grazed down where stock have access to it. North Vermilion Creek, July 19 (3770); Granger, July 30 (3873); Grand Encampment Creek, August 13 (4001).

Carex marcida alterna Bailey.—This form is very similar to the preceding in its habit of growth. In one locality it was found very abundant on both the drier and wetter ground of the meadows. Wagon Hound Creek, August 21 (4401).

Carex multinoda Bailey (MANY-JOINTED SEDGE).—A particularly handsome sedge, the numerous flat, green leaves and the slender stems, surmounted by comparatively large heads, give it the appearance of a valuable plant. It is, however, a bog form and hence difficult to utilize. Centennial Valley, July 2 (3275); "G," Summer ranch, July 23 (3822); Grand Encampment Creek, August 13 (3996).

Carex nebraskensis Dewey (NEBRASKA SEDGE).—This swamp sedge is very variable in size, but often attains a height of 2 feet or more. The leaves are very abundant, relatively broad and often nearly as long as the stems, on which are borne two to four large cylindrical heads. Though the hay produced from it will not weigh very heavy in proportion to the bulk, yet it must be considered as a valuable product. In meadows that are flooded early in the season it constitutes a considerable part of the whole hay crop. Pine Bluffs, July 7 (3654); Evanston, July 27 (3830); Cooper Hill, August 22 (4409).

Carex nebraskensis praevia Bailey.—Green Top, June 29 (3256); Medicine Bow River, August 21 (4094).

Carex nigrescens C. A. Meyer.—Springing from underground root-stocks, producing an abundance of short root leaves, few naked stems, 6 to 9 inches high; in wet places in the alpine regions of the mountains. Battle Lake Mountain, August 17 (4042).

Carex nova Bailey (The New Sedge).—Erect and slender, stemmed with short flat leaves; 15 to 25 inches high; somewhat scattering, in the wet spruce woods and along the creeks in the mountains. Probably of value as pasture. Battle Lake, August 16 (4007).

Carex preslii Steud. (Presl's Sedge).—A tufted alpine form with numerous soft, slender leaves that are greatly relished by grazing animals; 8 to 10 inches high. Battle Lake Mountain, August 17 (4053).

Carex pyrenaica Wahl.—A very small, tufted form, only a few inches high, strictly alpine, observed only about the permanent snowdrifts on the mountains. Battle Lake Mountain, August 17 (4058).

Carex raynoldsii Dewey (Raynolds' Sedge).—Erect but weak stemmed, leaves broad and flat; the short cylindrical heads usually two, a foot or more high; rare and very scattering. Battle Lake, August 16 (4020).

Carex scirpoidea Michx. (Rush-like Sedge).—Erect with an abundance of short root leaves, only 6 to 10 inches high. It develops early on wet ground on bottom lands and so furnishes a perceptible part of the spring pasture. Pine Bluffs, May 15 (2901); Laramie, May 31 (2943).

Carex siccata Dewey (Hillside Sedge).—From strong, tufted root-stocks, slender stems and numerous leaves as long as the stems. This is a dry-ground sedge, being abundant on fertile hillsides, where it develops early and gives much valuable pasture. Evanston, May 29 (3001); also frequently collected in the Laramie Hills.

Carex stenophylla Wahl. (Dwarf Sedge).—This is the earliest on the Laramie plains, but in many places it also maintains itself till late in the season. It often forms a fairly uniform growth, but its small size (4 to 6 inches in height) and slenderness make it seem rather insignificant. As spring pasture on the plains, it has value. Colorado-Wyoming line, Sweetwater County, July 23 (3803); Grand Encampment Creek, August 13 (3991).

Carex tenella Schk. (Soft-leafed Sedge).—A very delicate, slender-stemmed and soft-leafed plant, a foot or less high, usually in damp, shaded places; never observed in sufficient abundance to have any economic significance. Woods Creek, August 9 (3941).

Carex tolmiei Boott.—A stout, mountain form with long, broad leaves, a foot or so high, usually as strongly root-tufted bunches. Not abundant enough to have much significance but evidently relished by grazing animals. Battle Lake, August 16 (4005 and 4072).

Carex trichocarpa aristata Bailey (Awned Sedge).—One of the largest of the sedges, stems thick and producing a succession of heads, the leaves broad, flat, and often overtopping the stems, the whole producing a very dense growth 3 to 4 feet high. It prefers very wet ground, but produces abundantly on ground that dries out in late summer. I have seen considerable areas yielding an immense amount of forage harvested with the usual machinery. Laramie, September 15 (4469).

Carex trichocarpa imberbis Gray (?).—This is much smaller than the preceding with longer, denser heads; somewhat tufted and usually growing in the margins of creeks or ponds; not plentiful. North Vermilion Creek, July 20 (3802).

Carex utriculata minor Boott. (Small Bottle Sedge).—A rank-growing sedge of the wettest ground, with thick stems and long, broad leaves, often 2 or 3 feet in height; heads usually three to four on each culm. It is very abundant and widely distributed; on grounds that become sufficiently dry to admit of it, it is cut and is said to form fair hay. Head of North Vermilion Creek, July 20 (3801); Evanston, July 28 (3861); Johnson's Ranch, Big Laramie, August 8 (3896); Battle Lake, August 16 (4036).

Carex vallicola Dewey.—Soft-leaved and slender stemmed, less than a foot high; on the hillsides, not abundant. Evanston, May 29 (3000).

Carex variabilis Bailey (?).—A slender, erect form usually found in the margins of streams, 12 to 20 inches. Pine Bluffs, May 15 (2900).

Carex variabilis elatior Bailey.—A bunch sedge of the most pronounced sort, so tufted that it can scarcely be broken up, leaves abundant and stems fruiting freely, 20 to 30 inches high. Probably of small economic value. Woods Creek, August 9 (3937); Grand Encampment, August 13 (3985).

Carex eleocharis Bailey (?).—Filiform stems and leaves from tuberous root-stocks, only 5 to 8 inches high. It makes a very close growth and has the aspect of an *Eleocharis*. In the locality where it was secured it was exceedinaly abundant in the drier parts of the meadows, even to forming continuous sods. Big Creek, August 11 (3972).

Carex sp.—A small, leafy species, 6 to 8 inches high, somewhat tufted and forming a considerable growth on saline ground bordering some lakes. Little Laramie River, July 24 (3445).

OTHER FORAGE PLANTS.

Besides the grass-like plants given in the preceding list there are many in the region designated the summer range, that furnish much browsing during the summer months, but these need not be mentioned in detail here. It is sufficient to call attention to the following as among the more important:

First in importance are *Leguminosæ*, which throughout the entire range are abundantly represented. Species of *Astragalus* abound everywhere and many of them are freely eaten. In view of the fact that some (*Astragalus mollissimus*, etc.) have reputed poisonous properties, it is a question yet to be solved how generally they may be accepted as forage plants. Species of *Thermopsis*, abundant in some localities, are not without suspicion of having injurious properties. Among the legumes that pass unchallenged may be named the clovers (*Trifolium longipes* Nutt., and other species) and Hedysarum (*H. americanum* Britt. and *H. mackenzii* Rich.), all of which are of frequent occurrence and in some localities abundant. These are greatly relished by stock and furnish an important part of the pasture.

In the eastern part of the State another genus that is particularly well represented is *Psoralea*, the following species being abundant: *P. lanceolata* Pursh, *P. linearifolia* T. & G., and *P. tenuiflora* Pursh. Of the value of these species the writer can not speak for he does not even know that stock feed upon them.

Attention may be called to the following list, the plants of which are abundant in the summer range as well as in the desert. (For more or less complete notes upon their economic value see the Red Desert list (p. 24) in which they have been individually considered.)

Astragalus.
Lupinus.
Vicia.
Atriplex.
Eurotia lanata.
Chenopodium.
Sarcobatus.
Sueda.
Eriogonum.
Artemisia.

FLORA OF THE RED DESERT.

The Red Desert is a fairly distinct area, an area with a flora peculiar to and characteristic of an arid, saline region. Its plants are therefore listed separately, and all vascular forms that were secured are included, whether they are forage plants or not. This is done to indicate as fully as possible the real character of the vegetation and thus, by inference, the economic possibilities of the region.

The following list of plants is based upon specimens secured during the summer of 1897 along the line of the Union Pacific Railroad, from Pine Bluffs, on the eastern border, to Evanston, on the western border of the Desert. There are represented, besides the districts contiguous to the road, localities both north and south, some of which are from 40 to 70 miles distant from it. As the following are but the collections of one season, they must fall far short of constituting the complete flora of the region.

CONIFERÆ.

Juniperus knightii A. Nels. (DESERT JUNIPER).—Usually a shrub-like tree, much branched from the base, but occasionally more arboreous. Common in the sandstone bluffs along Bitter Creek and its tributaries. (See p. 7.) Point of Rocks, June 1 (3096); Rock Springs, July 26.

SCHEUCHZERIACEÆ.

Triglochin maritima L. (SEASIDE ARROW-GRASS).—A low, tender, herbaceous plant, 6 to 10 inches high, abundant on wet alkali flats; possibly eaten by stock to some extent. South Butte, July 13 (3748).

GRAMINEÆ.

Stipa comata Trin. & Rupr. (NEEDLE-GRASS).—A loosely spreading bunch grass, easily known by the long, twisted awns that the fruits bear. A grass of some forage value and readily eaten by stock in the autumn and winter after the long, vicious beards have fallen. Bitter Creek, July 12 (3700).

Stipa lettermani Vasey (LETTERMAN'S NEEDLE-GRASS).—A slender form with short awns, growing as a bunch grass among the sage-brush on the dry summits of the hills. Probably in itself valuable, but only occurs in small quantity. South Butte, July 13 (3738).

Stipa nelsoni Scribn. (NELSON'S NEEDLE-GRASS).—A tall grass, with very long heads and awns of medium length, forming small and rather loose bunches, with a fair amount of leaves; usually found in open-timbered areas, but also among the sagebrush on the slopes below the permanent winter snowbanks; not plentiful. Fifteen-Mile Springs, July 13 (3731).

Eriocoma cuspidata Nutt. (INDIAN MILLET, see fig. 2).—A widely distributed bunch grass, from a few inches to a foot or more in height, easily known by its peculiarly branched panicles and the large, softly silky seeds. It is a grass of much value. Point of Rocks, June 1 (3094); Red Desert, June 3 (3122); Wamsutter, July 10 (3680); Creston, August 28 (4416).

Sporobolus airoides Torr. (FINE-TOP SALT-GRASS, see fig. 6).—This grass forms patches of various sizes on the hummocks and drier ridges of bottom lands. The sod seems stiff and the stems, while somewhat slender, are also rather rigid. It forms, however, in some localities much valuable pasture. Black Rock Springs, July 13 (3723); Green River, September 1 (4457).

Sporobolus depauperatus Scribn. (Dropseed).—A small but valuable grass, forming a close, even sod of numerous slender leaves and stems; valuable as pasture, but of rare occurrence in the desert. South Butte, July 13 (3745); Creston, August 29 (4425).

Calamagrostis hyperborea americana Kearn. (Sand-grass; Yellow Top).—A tall, slender grass, usually forming an even growth, on wet ground in either open or shaded places. Rare in the desert, occurring only about spring bogs. Black Rock Springs, July 13 (3717).

Calamagrostis neglecta Gaertn. (Pony-grass).—An erect grass usually found in the margins of ponds and ditches, forming an even growth and bearing an abundance of slender leaves; a fine appearing and valuable grass. South Butte, July 13 (3750).

Deschampsia caespitosa Beauv. (Tufted Hair-grass).—A bunch grass with slender stems and numerous leaves, common throughout the State, sometimes in comparatively dry ground, but usually along streams and about spring bogs. It furnishes much pasture, but after it matures and dries on the ground it does not seem to be relished by stock. Black Rock Springs, July 13 (3718); Fifteen-mile Springs, July 14 (3727).

Koeleria cristata Pers. (Prairie June-grass).—A straight, slender grass with cylindrical heads, forming small tufts, 8 to 12 inches high. Common on the plains and in the hills, and forming an important part of the early pasture; far from common in the Red Desert. Creston, August 28 (4417).

Catabrosa aquatica Beauv. (Water Whorl-grass, fig. 22).—A soft, watery grass, usually with stems partly prostrate and rooting in the soft mud of the sluggish streams and spring-fed bogs, where it abounds. Horses and cattle eat it readily and will wade knee-deep in the mud to secure it. South Butte, July 13 (3734).

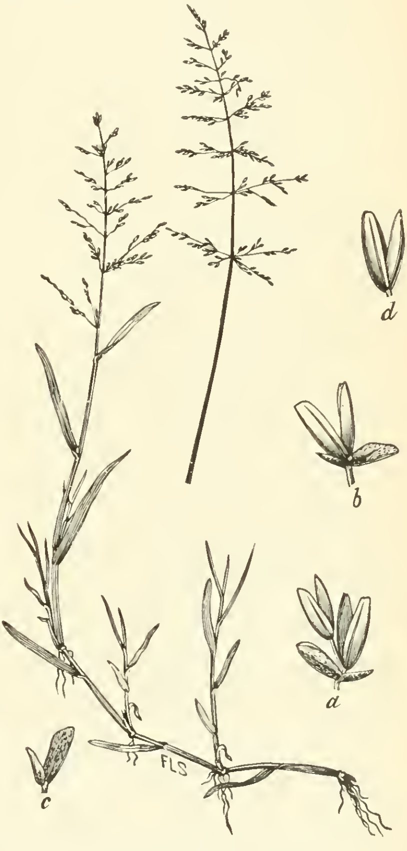


Fig. 22.—Water Whorl-grass (*Catabrosa aquatica*): *a*, *b*, spikelets; *c*, *d*, florets.

Distichlis spicata Greene. (Salt-grass; Alkali-grass).—A stiff, pale, harsh grass, occurring on alkali flats, even where the ground is white with salt. Though far from the best, it is eaten down by stock where other forage is scarce. Black Rock Springs, July 13 (3722).

Poa buckleyana Nash. (Bunch-grass).—A slender-stemmed, narrow-leafed bunch-grass of much value in this State, but of small significance in the Desert proper. On some of the moister slopes and draws it becomes of some importance. Green River, June 1 (3067); Bitter Creek, June 2 (3100); Creston, August 28 (4418).

Poa juncifolia Scribn. (Alkali Blue-grass, Pl. V).—A small, erect bunch-grass with slender, pointed leaves. This new species belongs to the arid region, but it is not confined to the desert exclusively. Usually of scattering growth, it sometimes forms almost a continuous sod. Reported as one of the desirable pasture grasses, and would probably be of value as a meadow grass, especially where the soil and the irrigation waters are not of the best. Black Rock Butte, July 13 (3721).

Poa laevigata Scribn. (SMOOTH BUNCH-GRASS).—This species is found throughout the southern part of the State, in the desert as well as in the hills and mountains, sometimes in comparatively dry places, but preferring moist banks and wet flats. It forms a valuable part of the early summer forage. Red Desert, June 3 (3118); Pole Creek, June 19 (3197); Wamsutter, July 10 (3668); Bitter Creek, July 12 (3708); Point of Rocks, July 14 (3751).

Poa lucida Vasey (SHINING BUNCH-GRASS.)—A grass of more than usual importance. It grows to a height of 1 or 2 feet, producing numerous stems and broad leaves of excellent quality. It constitutes an appreciable part of the forage in the desert as well as in the summer range. It is found on the dry plains, but is more abundant and luxuriant in the vicinity of spring bogs and creeks. Point of Rocks, June 1 (3093); Bitter Creek, July 12 (3707); South Butte, July 13 (3733).

Poa sheldoni Vasey (SHELDON'S BLUE-GRASS).—Bitter Creek, July 12 (3696).

Puccinellia airoides Wats. & Coult. (ALKALI MEADOW-GRASS).—This slender, erect grass is seldom seen except in the margins of ponds and ditches, and seems to prefer water with a considerable percentage of alkali. Whether it could be introduced to advantage on wet alkali ground the writer is unable to say, but that stock will readily eat it when fresh is well known. Bitter Creek July 12 (3687); Black Rock Springs, July 14 (3715); South Butte, July 14 (3737).

Agropyron dasystachyum subvillosum S. & S. (NORTHERN WHEAT-GRASS).—An erect grass with slender heads and numerous slender, somewhat spreading root-leaves. On the dry plains it is of small size (6 to 10 inches high), but on bottom lands or under irrigation it makes a luxuriant growth. It cures readily on the ground and forms a valuable part of the winter pasture and must also be reckoned among the valuable meadow grasses. Wamsutter, July 9 (3679); Fifteen-Mile Springs, July 14 (3730).

Agropyron spicatum S. & S. (WESTERN WHEAT-GRASS).—A somewhat coarse and harsh wheat-grass but nevertheless of much value; not abundant in the desert but in some of the draws in sufficient amount to possess forage value. Wamsutter, July 10 (3672); Black Rock Butte, July 14 (3724).

Agropyron spicatum molle S. & S.—This seemed to be the commonest of the wheat grasses in some parts of the desert, as, for instance, in the clay gumbo on the banks of Bitter Creek. It impresses one as a grass that would be of value in meadows where soil and irrigation water are both of poor quality. Wamsutter, July 10 (3674); Bitter Creek, July 12 (3706); Point of Rocks, July 12 (3713).

Agropyron tenerum Vasey (SLENDER WHEAT-GRASS).—A slender-stemmed grass with very slender heads and rather sparsely leaved, from 15 to 30 inches high. Probably the most important wheat-grass in southern Wyoming. Bitter Creek, July 12 (3709); South Butte, July 13 (3736).

Agropyron tenerum ciliatum S. & S.—In general appearance and in value much like the preceding but of rarer occurrence; hence among the native forage of little importance, though under cultivation and irrigation it has proved a most desirable form. Wamsutter, July 11 (3677).

Agropyron vaseyi S. & S. (VASEY'S WHEAT-GRASS).—This forms dense bunches of some inches or even a foot in height. It will hardly be thought of as a wheat-grass on account of the numerous spreading awns, but it is a valuable grass on account of the early forage it furnishes on otherwise barren slopes and shaly hilltops. Stock eat it readily, especially while it is young. Bitter Creek, July 12 (3695).

Hordeum jubatum L. (SQUIRREL-TAIL GRASS).—This, so commonly called fox-tail in this region, is too well known to need any description. It is the most undesirable grass of the West. Though considered an annual, it will probably be found to be longer lived in some places at least; common in the desert in many wet alkaline places, especially along the railroad. Wamsutter, July 10 (3670).

Hordeum nodosum L. (MEADOW BARLEY).—A slender bunch grass, or sometimes a rather continuous and uniform growth, forming small meadow-like tracts on saline flats and basins. It is a light grass, and the short-bearded heads soon break up when mature, but if cut early and cured would probably make fair hay. Bitter Creek, July 12 (3692); South Butte July 13 (3746).

Elymus condensatus Presl. (GIANT RYE-GRASS).—A tall, coarse grass growing in dense bunches. It is common in the deeper draws and on the slopes below the permanent winter snowdrifts. Wamsutter, July 10 (3675); Fifteen-mile Springs, July 14 (3728).

Elymus salinus Jones (DESERT RYE-GRASS, fig. 23).—Varying from a small, erect form of scattering growth to a coarse, harsh plant a foot or more in height, forming close tufts. It seems to be peculiar to dry, poor soil, usually occupying the driest ridges and benches of the second bottom or the sand dunes of the foothills. Only rarely does it form a uniform, continuous growth. It seems that it might prove a valuable grass for certain kinds of soil, both for pasture and hay. A very moderate amount of water for irrigation would probably suffice to secure fair results. Green River, May 31 (3059); Bitter Creek, July 12 (3694); Point of Rocks, August 30 (4436).

Sitanion elymoides Raf. (LONG-BEARDED WILD-RYE).—A small bunch grass with wide-spreading awns. It can hardly be pronounced other than worthless. It has not only formidable beards, but it matures early, becomes brittle, and soon goes to pieces and is blown away. Green River, May 31 (3058); Wamsutter, July 10 (3669).

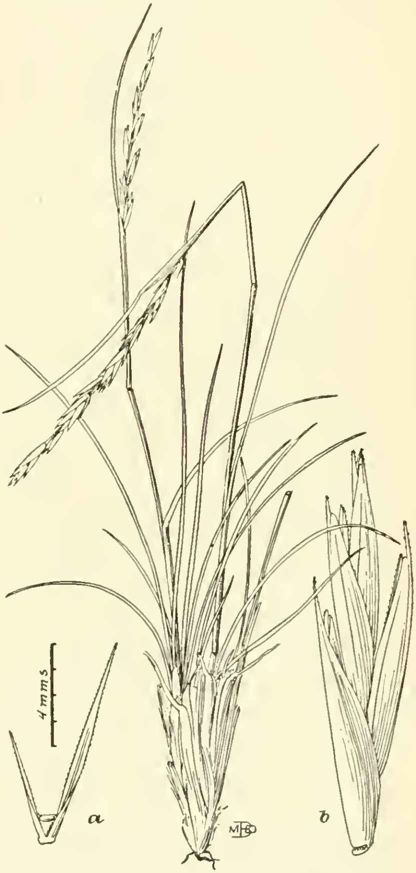


FIG. 23.—Desert Rye-grass (*Elymus salinus*): *a*, empty glumes; *b*, florets.

CYPERACEÆ.

Eleocharis palustris R. & S. (COMMON SPIKE-RUSH).—Slender stems 10 to 18 inches high; spikes narrowly oblong. An exceedingly common form in the saline bogs of the desert; especially abundant on the low banks of Bitter Creek, where it was freely browsed by the horses on the emigrant trail. Bitter Creek, July 12 (3689).

Eleocharis sp.—Much smaller than the preceding, with short, oblong spikes, making a dense growth on the black, mucky bogs about springs in the desert. Readily eaten by our horses while we were in camp. Black Rock Springs, July 13 (3719).

Scirpus americanus Pers. (AMERICAN BULRUSH).—Perennial from slender rootstocks; stems triangular, erect, moderately stout; leaves long and abundant. Remarkably abundant on the banks of Bitter Creek and in some of the spring bogs. Fifteen Mile Springs, July 14 (3726); Point of Rocks, July 12 (3714); South Butte, July 14 (3740).

Scirpus campestris Britt. (PRAIRIE BULRUSH).—An exceedingly leafy species developed from tubers, which are annually produced at the end of short, horizontal root-stocks. Bitter Creek, September 3 (4459).

Carex marcida debilis Bailey.—This is a small sedge with numerous weak stems from a thick, horizontal root-stock, only 6 to 9 inches high; on the drier ridges about the spring bogs; not abundant. Black Rock Springs, July 13 (3720).

Carex multinoda Bailey.—This slender-stemmed sedge produces a large amount of long, tender leaves, and forms a close sod. It is one of the most valuable from a forage standpoint of the sedges of the desert. South Butte, July 13 (3735).

Carex nebraskensis Dewey (NEBRASKA SEDGE).—Very leafy, the leaves broad, almost as long as the stems. 1 to 2 feet or more in height. Usually in very wet ground, such as ditches and meadow bogs. When these dry out in late summer it is cut to a considerable extent for hay. It of course occurs in the desert only rarely, but in some of the bogs it is quite abundant. South Butte, July 13 (3741).

Carex stenophylla Wahl.—A small, scattering form only a few inches high, usually developing early; among the sagebrush in the desert it is too scattering to have any significance. Creston, August 28 (4415).

Carex teretiuscula Good.—This form has very slender, almost cylindrical leaves and stems but makes a very close and even growth on wet saline soil, often in patches of considerable size. Black Rock Springs, July 13 (3716 and 3725); South Butte, July 13 (3734a).

JUNCACEÆ.

Juncus balticus Willd. (BALTIC RUSH).—A well-known rush with rather rigid stems which arise quite regularly from a creeping, underground root-stock. It varies greatly in both size and habitat. In wet ground, as in the margins of a stream, it may attain a height of 3 feet or more; on dry sandy slopes, where it was sometimes found to occur in the desert, it may be scarcely a foot high. It probably has little forage value, though it is eaten to some extent with the other vegetation when intermingled with it. Point of Rocks, June 1 (3095); Bitter Creek, July 12 (3690).

Juncus confusus Coville.—A slender form of compact growth, 10 to 15 inches high. In some of the deeper draws in the desert where the spring snows lie late this forms extensive patches of close sod. Whether it is eaten to any extent by stock of any kind the writer is unable to say. Creston, August 29 (4427).

Juncus xiphioides montanus Engelm.—Tall and slender with ample flat leaves, 20 to 30 inches high. It is abundant in many of the spring bogs, and seems to be freely browsed by stock. South Butte, July 13 (3739).

LILIACEÆ.

Allium mutabile Michx. (WILD ONION).—Peculiar among the wild onions in that it sometimes produces little bulbs in the inflorescence. All of the specimens collected bore bulblets. Not common. In a draw among the hills north of Rock Springs. The Gap, July 25 (3600).

Allium reticulatum Don. (FRASER'S WILD ONION).—A common form on the slopes of the hills throughout the desert. Green River, May 31 (3033); Point of Rocks, June 1 (3076).

SALICACEÆ.

Salix cordata mackenzieana Hook.—This willow becomes a small, rather shapely tree. It seems to be a very common form on the banks of Green River and some of its tributary creeks. Green River, May 31 (3066).

Salix fluviatilis Nutt. (RIVER-BANK WILLOW).—This little slender-stemmed and slender-leafed form so common on all creek and river banks seems to be equally common on the banks of Bitter Creek and its tributaries. It forms a green fringe or even large patches on the low, salt-encrusted banks. Not usually thought to have any value, but here in the desert occasionally browsed by sheep, especially when snow makes other feed hard to obtain. Bitter Creek, June 2 (3102).

Salix bebbiana Sargent. (BEBB'S WILLOW).—It was something of a surprise to find this willow in the heart of the desert. In a draw near the railroad at Creston, August 27 (4270).

POLYGONACEÆ.

Eriogonum campanulatum Nutt. (NARROW-LEAFED ERIOGONUM).—Often browsed by cattle, but of no considerable value. The Gap, north of Rock Springs, July 25 (3597).

Eriogonum effusum Nutt.—A small, branched plant with a woody base, the young stems tender and eaten by sheep; not plentiful. In the clay draws at the head of Salt-Wells Creek, July 17 (3753).

Eriogonum ovalifolium Nutt.—A small cæspitose plant, exceedingly common on both plains and hills. There are several forms of it, the commoner one having white flowers, but in the desert, where it is especially abundant, bright yellow forms predominate. It is probably of no economic importance. Point of Rocks, June 1 (3087); Bitter Creek, June 2 (3099); Red Desert, June 3 (3117).

Rumex tuberosum A. Nels. (TUBEROUS DOCK).—On some of the alkali-covered flats adjacent to Bitter Creek this unusual plant was found. A dock springing from large oblong tubers which lie shallowly buried in the loose, ash-like alkali soil. From these the plants spring up early, the stems, a foot or more in height, bearing long spikes of flowers; the large, bright-red wings of the fruits make them very conspicuous on the otherwise almost naked ground. Bitter Creek, June 2 (3114).

CHENOPODIACEÆ.

Chenopodium album L. (LAMB'S QUARTERS).—This well-known weed seems to be at home even in the desert, except in the more pronounced of its alkali soils. Wamsutter, July 10 (3685); Bitter Creek, July 12 (3705).

Chenopodium fremontii Wats. (FREMONT'S GOOSEFOOT).—A succulent, branched, leafy plant, 1 to 2 feet high; if growing thickly it is more slender and less leafy. This must be placed among the plants of possible forage value. It thrives on saline soil, in some localities making a pure growth, and if it can be shown that it has forage value large crops of it can readily be grown. Wamsutter, July 10 (3671).

Chenopodium glaucum L.—This is a spreading form of goosefoot with thick, fleshy leaves, and succulent stems. It thrives in soil impregnated with alkali, and, as was said of the preceding one, if it has any value, large crops of it can be grown on otherwise worthless alkali soils. Bitter Creek, July 12 (3704).

Chenopodium leptophyllum Nutt. (NARROW-LEAFED GOOSEFOOT).—A slender, willowy form, a foot or so in height. Bitter Creek, July 12 (3704*a*).

Blitum capitatum L. (STRAWBERRY BLITE).—This seems to be very rare, only a few specimens being seen. South Butte, July 13 (3544).

Monolepis nuttalliana Greene.—A small, much branched, succulent plant, 5 to 7 inches high, common on saline soils throughout the West. Wamsutter, July 11 (3686).

Atriplex argentea Nutt. (SILVERY SALT-SAGE).—A branched, annual plant, with silvery leaves and stems, common about alkali lakes. Possibly it has forage value during its season, but when mature it seems to become dry and worthless. Howell Lakes, September 1 (1466).

Atriplex confertifolia (Torr.) Wats. (SPINY SALT-SAGE.)—A much-branched, spiny shrub, 15 to 20 inches high, producing early in the season a large amount of thick, succulent leaves and enormous quantities of flat, winged seeds. The leaves and seeds are greatly relished by sheep. Green River, May 31 (3044); Bitter Creek, July 12 (3701); Spring Creek, August 18 (4248); Point of Rocks, August 30 (4431).

Atriplex expansa Wats. (Spreading Salt-sage).—A slender-branched, silvery annual, with small, triangular leaves; common on alkali flats, where it sometimes forms a continuous growth. To be of value it would have to be harvested shortly before it was mature. If left to mature on the ground it is of little value. Wamsutter, July 10 (3673).

Atriplex hastata Linn. (Spreading Orache).—Usually a tall, coarse, weed-like plant, often widely branched; either on saline or on salt-free ground, dark green or rarely somewhat scurfy. Probably of little value. Mud Springs, July 16 (3752).

Atriplex nuttallii Wats. (Nuttall's Salt-sage).—A perennial with shrubby base and spreading branches; leaves thick and succulent, numerous; seeds abundant. This is the plant that the sheep man has particularly in mind when he speaks of salt-sage. It is the most important forage plant of the desert. Green River, May 31 (3060); Red Desert, June 3 (3121); Wamsutter July 10 (3667).

Atriplex pabularis A. Nels. (Nelson's Salt-sage).—An erect, slender-stemmed perennial, 8 to 16 inches high, producing a large number of succulent leaves and much fruit. As a promising fodder plant for strongly saline soil it is certainly worthy of trial. Point of Rocks, July 12 (3712); August 30 (4429); Granger, July 30 (3893).

Atriplex truncata Gray.—A much-branched, silvery annual that grows luxuriantly on the saline soils of the desert in many places. It would yield a large quantity, if not very good quality, of fodder if cut before maturity. Point of Rocks, August 30 (4430).

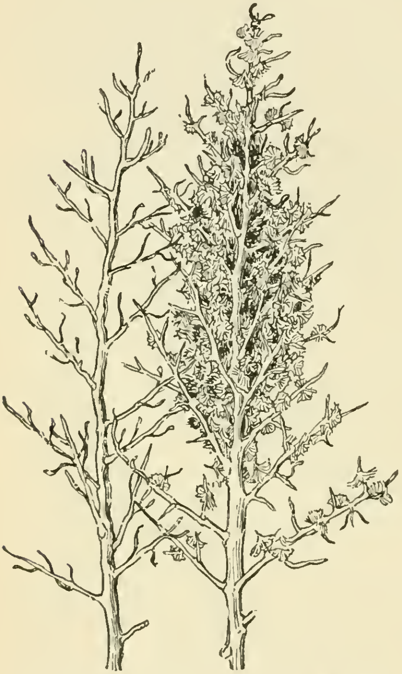


Fig. 24.—Grease-wood (*Sarcobatus vermiculatus*).

Eurotia lanata Moquin. (Winter-fat; Sweet Sage).—A well-known, much-branched plant, a foot or more high from a shrubby base, white, with long hairs when young, darker when old. Exceedingly common throughout the region; highly prized as sheep feed, especially in the desert. Wamsutter, July 10 (3682).

Kochia americana Wats.—A small plant, much branched from the woody base, 6 to 10 inches high. The tender annual shoots are eaten by stock, and form a part of the spring forage; the younger twigs are also browsed to some extent during the winter months. Green River, May 31 (3043); South Butte, July 13 (3743); Point of Rocks, August 30 (4439).

Sarcobatus vermiculatus Torr. (Grease-wood, fig. 24.)—An erect shrub with spiny branches, very variable in size; usually not more than 2 or 3 feet high, but sometimes 6 or 8, with wide-spreading branches. Even this contributes to the sheep feed in the desert, the slender, fleshy leaves and the numerous winged seeds being greedily eaten, as well as the more tender twigs. Wamsutter, June 4 (3130); Bitter Creek, September 3 (4456).

Grayia spinosa Moquin. (SPINY-SAGE).—A branched, spiny shrub, with oblong, thick, succulent leaves. It produces enormous quantities of flat, winged seeds. These, with the leaves, fall early, and are collected by the wind into little drifts or piles under the bushes and in the hollows of the ground. When sheep are fed over the ground these leaf piles are the first to disappear. Abundant on the slopes of the hills adjacent to Bitter Creek and its tributaries. Green River, May 30 (3029); Bitter Creek, July 12 (3698).

Dondia diffusa Heller.—A small, succulent annual, a few inches in height; common on wet alkali flats. Probably of small forage value. South Butte, July 13 (3749).

Dondia multiflora Heller (SHRUBBY BLITE).—A small plant with numerous succulent stems from a woody base, 6 to 12 inches high; common in alkali basins and on the banks of Bitter Creek. Its forage value unknown. Green River, May 31 (3042).

Salsola tragus L. (RUSSIAN THISTLE.)—A much-branched, succulent spiny annual, becoming a tumbleweed when mature. It is still rare in the desert. Observed only at Rock Springs and Green River.

NYCTAGINACEÆ.

Abronia sp.—Probably a new species, but lacking fruits, without which it can not be sufficiently characterized for publication. On the dry bluffs. Green River, May 30 (3021).

CARYOPHYLLACEÆ.

Silene menziesii Hook. (MENZIES'S PINK).—A small, leafy, branching perennial, growing on wet banks, varying in height from a few inches to a foot. Observed but once in the desert. Bitter Creek, July 12 (3532).

Arenaria congesta Nutt. (BUNCH SANDWORT).—A small, erect plant, growing in bunches 4 to 6 inches high, with grass-like stems and leaves, and bearing a globular head of flowers. It is not known whether this is eaten by stock. Very abundant on some of the sage-brush slopes in the desert. South Butte, July 13 (3732).

Arenaria hookeri Nutt. (HOOKER'S SANDWORT).—A strongly matted plant, only a few inches high, with rigid, pointed leaves and white, star-like flowers. Common on dry, rocky points. Green River, June 1 (3069).

Arenaria nuttallii Pax. (NUTTALL'S SANDWORT).—A low plant with spreading stems and pointed leaves, occasional on the driest, shaly slopes. Green River, May 31 (3054).

RANUNCULACEÆ.

Oxygraphis cymbalaria Prantl. (SEASIDE CROWFOOT or BUTTERCUP).—A low, smooth buttercup, spreading by runners; common on wet or marshy saline soil everywhere. Noted in very many places in the desert.

CRUCIFERÆ.

Stanleya pinnata Britton.—Erect, with entire or incised leaves, 2 to 3 feet high; flowers yellow, in a long spike. Green River, May 30 (3034).

Stanleya pinnata integrifolia Robs.—Somewhat similar to the preceding, but with all the leaves entire. Rock Springs, July 25 (3596).

Thelypodium sp.—A slender, branching form, occasionally seen on the Green River bluffs; the species not yet determined. May 30 (3034*a*).

Lepidium medium Greene (WESTERN PEPPERGRASS).—A much-branched annual, 6 to 12 inches high. Flowers very numerous, inconspicuous. Abundant in some of the sandy draws of the desert. Point of Rocks, June 1 (3092).

Lepidium montanum Nutt. (LARGE-FLOWERED PEPPERGRASS).—Tufted perennial with numerous stems, 4 to 8 inches high; petals white and unusually large for the genus. It seems to prefer saline soil. Bitter Creek, June 2 (3106).

Sisymbrium canescens Nutt.—A slender, branching mustard with yellow flowers; the most abundant mustard in the desert, sometimes forming considerable fields of yellow among the sage-brush on sandy slopes, or in the draws. Point of Rocks, June 1 (3078); Wamsutter, June 4 (3126).

Sisymbrium linifolium Nutt.—A mustard with slender stems, simple or several from the base; leaves entire or nearly so, smooth. Very abundant in many places throughout southern Wyoming. Wamsutter, June 4 (3127).

Physaria sp. (?).—A small, leafy perennial of the double bladder-pod crucifers. Rather abundant on the dry shale cliffs. Green River, May 30 (3032).

Bursa bursa-pastoris Britton (SHEPHERD'S PURSE).—This was noted in several places along the railroad.

Draba glacialis Adams (WHITLOW-GRASS).—A small, tufted crucifer, scarcely more than 1 inch high. Green River, June 1 (3071).

Arabis canescens Nutt. (ASHY ROCK-CRESS).—A slender, sparingly branched perennial, about 1 foot high, common in some sandy draws among the sage-brush. Point of Rocks, June 1 (3077).

Arabis brebneriana A. Nels. (BREBNER'S ROCK-CRESS).—A form rare in the locality. Fort Steele, June 5 (3135).

Streptanthus longirostris Wats.—Sparingly branched, from 1 to 2 feet high; frequent on the sandy river bottom. Green River, May 31 (3040); Point of Rocks, June 1 (3082).

CAPPARIDACEÆ.

Cleome lutea Hook. (YELLOW CLEOME).—An erect, glabrous, somewhat branched herb, 1 to 2 feet high, flowers yellow, and the pod borne on a long, slender stipe. Abundant on the sandy bottoms. Green River, May 31 (3046).

SAXIFRAGACEÆ.

Heuchera parvifolia Nutt.—Perennial from a thick root, with a rosulate cluster of root-leaves and slender leafless stems, bearing short spike-like panicles of small flowers, 9 to 18 inches high. Infrequent; on the slopes below the winter snowdrifts. South Butte, July 13 (3540).

Philadelphus occidentalis A. Nels. (WESTERN SYRINGA).—A branched shrub, 3 to 5 feet high, peculiar to dry, desert canyons. It was an agreeable surprise to find a clump of this syringa in one of the canyons near Rock Springs, July 15 (3595).

ROSACEÆ.

Holodiscus dumosus Heller.—A branched shrub, 2 to 5 feet high; very rare within the borders of the desert; only below the permanent winter snowdrifts. South Butte, July 13 (3536).

Potentilla glandulosa Lindl. (GLANDULAR CINQUEFOIL).—A handsome perennial plant, some 18 to 30 inches high, sparingly branched; flowers yellow. Only on moist slopes below snow banks. South Butte, July 13 (3534).

Potentilla anserina L. (SILVER-WEED).—A tufted, spreading plant, common on wet, saline soil everywhere in the desert as well as elsewhere in the State.

Geum macrophyllum Willd. (LARGE-LEAFED AVENS).—A perennial herb, a foot or two in height, sometimes branched above, with large, lobed root-leaves on long petioles. Infrequent; on the moist slopes below the winter snow banks. South Butte, July 13 (3543).

Cercocarpus parvifolius H. & A. (MOUNTAIN MAHOGANY).—A stiff, scraggy shrub, 3 to 6 feet high; common on rocky slopes throughout the southern part of the State. Observed in several places in the desert on the winter snow slopes.

DRUPACEÆ.

Prunus demissa Walp. (WESTERN WILD CHERRY).—A shrub or small tree, varying greatly in size in different situations. In the desert it occurs only below the brow of some of the steeper hills, where the winter snows become piled and remain late in the season. Observed in a few localities and collected at The Gap, south of Rock Springs, July 25 (3599).

PAPILIONACEÆ.

Lupinus argenteus Pursh. (SILVERY LUPINE).—A perennial, bushy, branched plant, 1 to 2 feet high, bearing long, dense spikes of purple flowers; pods, silvery, silky, and containing only a few large seeds. In some of the grassy draws among the hills. Creston, August 29 (1428) The lupines seem to thrive in the desert, and if it could be shown that they have any economic value they could undoubtedly be cultivated.

Lupinus leucophyllus Dougl.—Somewhat similar to the preceding, but occupying drier situations. The driest bluffs and ridges do not seem to be unsuited to it. It is by far the commonest lupine in the desert, and great crops of it were observed even on the summits of the white Green River bluffs. Green River, May 30 (3023); Bitter Creek, June 3 (3109); Fifteen-Mile Spring, July 13 (3729).

Astragalus grayii Parry (GRAY'S MILK-VETCH).—A small, erect form, 8 to 12 inches, with yellowish-white flowers in a rather short raceme. Scattering and rare. Bitter Creek, June 3 (3115) and July 12 (3530).

Astragalus haydenianus nevadensis Jones.—This form was collected and noted in several places. Of unknown forage value. Bitter Creek, June 3 and July 12 (3116 and 3711).

Astragalus hypoglottis L. (PURPLE MILK-VETCH).—A low, spreading plant, only a few inches high, but often forming compact beds. It has the appearance of making excellent pasture, and looks as if it might be a good substitute for clover. Stock graze it down in some localities, and it is said that as an ingredient of hay, sheep pick this out first. It thrives on saline soil even where there is an excess of alkali, as for example on the low banks of Bitter Creek. There is no reason to think that it would be more difficult to secure a crop of this than of many other plants that are used for forage. The question that remains to be settled is, Are the plants of this genus nutritious and safe? Some of the species have reputed poisonous qualities; for example, *A. mollissimus*, one of the "locos." It is yet to be determined which are the valuable and safe species. Bitter Creek, July 12 (3688).

Astragalus megacarpus Gray (LARGE BLADDER-POD VETCH).—A spreading succulent plant with large, thin, inflated pods and small seeds. This also thrives in saline soil, forming large, green mats on the alkaline flats of Bitter Creek; June 3 (3113).

Astragalus sp.—An erect, slender-stemmed and slender-leafed form, found in the sandy slopes of the Bitter Creek hills. Point of Rocks, June 1 (3081).

Vicia dissitifolia Greene (AMERICAN VETCH).—A slender-stemmed, vine-like plant, climbing over other plants among which it is growing; vines 2 to 3 feet in length; accounted most excellent forage. On several occasions stockmen have brought specimens saying "If you can tell us how to secure enough of this we will be satisfied; we want nothing better." It makes excellent hay; sheep especially do well upon it. It is widely distributed, but rarely forms anything like a full crop of forage. The possibilities under cultivation are yet to be determined. Bitter Creek, July 12 (3703).

Vicia linearis Greene (NARROW-LEAFED AMERICAN VETCH).—Very similar to the preceding, but smaller in every way, with very narrow leaves. Equally valuable as forage, but not abundant. Bitter Creek, June 2 (3104).

LINACEÆ.

Linum lewisii Pursh. (Lewis's Wild Flax).—A plant with slender leaves and wand-like stems arising from a woody, perennial root, 1 to 2 feet high; common in the State, but rare in the desert. Red Desert, June 3 (3119).

ANACARDIACEÆ.

Rhus trilobata Nutt. (Stinking Sumach).—A small, glabrous, branching shrub; leaves, three-lobed; very common on dry ridges and canyon sides. Green River, May 31 (3065).

MALVACEÆ.

Malvastrum coccineum Gray (Red False Mallow).—A much-branched perennial herb, with silvery leaves and large, red flowers. Plant not more than a few inches high. Green River, May 31 (3057).

LOASACEÆ.

Mentzelia sp. (?).—A small form not yet determined; possibly new.

CACTACEÆ.

Echinocactus simpsoni minor Engelm.—A small, globular cactus; infrequent. South Butte, July 13 (3553).

Opuntia polyacantha Haw. (Many-spined Opuntia).—Composed of many flat, obovate joints, fiercely spiny. Very abundant. Wamsutter, July 11 (3523).

Opuntia polyacantha platycarpa Coulter.—In general appearance very similar to the preceding. Both are here often called Prickly Pear cactus. Bitter Creek, July 12 (3528).

ONAGRACEÆ.

Epilobium sp. (?).—Two species in this genus were collected, but they do not seem to agree exactly with any of the descriptions at hand, so they are left unnamed. Nos. 3542 and 4272, from South Butte and Creston, respectively.

Taraxia breviflora Nutt.—A small, stemless plant, with a cluster of root-leaves out of which the flowers hardly rise. Creston, August 29 (4273).

Anogra albicaulis Britton (Prairie Evening Primrose).—An herbaceous plant, with rather slender white stems, almost simple or branched from the base, 6 to 15 inches high; large white flowers, becoming pink as they grow older. Green River, May 31 (3064); Point of Rocks, June 1 (3075).

Chylisma scapoidea Small.—An herbaceous branching plant, with dark green leaves, and naked flowering stems, from a few inches to a foot high. Common especially on railroad embankments. Green River, May 30 (3025).

UMBELLIFERÆ.

Peucedanum macrocarpum Nutt. (Large-fruited Parsley).—A stemless form, with dissected leaves spreading out close to the ground, producing its flowers and large seeds early in the season; roots large and fleshy. Point of Rocks, June 1 (3086).

Cymopterus sp. (?).—A species of this genus that is as yet undetermined was secured at Point of Rocks, June 1 (3083).

GENTIANACEÆ.

Gentiana affinis Griseb. (Oblong-leafed Gentian).—A perennial with leafy clustered stems, 6 to 12 inches high. Common on low, wet ground. Point of Rocks, August 30 (4275).

POLEMONIACEÆ.

Phlox canescens T. & G. (Hoary Phlox).—A small, tufted, or matted form, blossoming early on the naked hills. Green River, May 30 (3030*a*).

Phlox douglasii longifolia Gray.—A small, rigid plant, with woody base and pungent leaves, only a few inches in height. Point of Rocks, June 1 (3081).

Gilia congesta Hook.—An erect, herbaceous plant, with spreading branches, 6 to 10 inches high; on sandy ground. Green River, May 31 (3015); South Butte, July 13 (3548).

Gilia cæspitosa A. Nels. (*Gilia pungens cæspitosa* Gray).—A much-matted form, with pungent leaves. Occurring frequently on the white chalk-like cliffs overlooking Green River. May 30 (3030).

HYDROPHYLLACEÆ.

Emmenanthe scopulina A. Nels.—A small, depressed annual, from the white bluffs, may be thus referred for the present at least. Bitter Creek, June 2 (3105).

Emmenanthe salina A. Nels.—Frequent in the abrupt, shale bluffs. Green River, May 30 (3026).

BORAGINACEÆ.

Lappula texana Britton (Western Stickseed).—An erect, almost simple or sometimes much branched, annual, 6 to 15 inches high. Common nearly everywhere in the State. Green River, June 1 (3068*a*).

Oreocarya flava A. Nels. (Yellow-flowered Oreocarya).—Stems numerous and spreading from deep-set roots, 4 to 8 inches long, yellowish-hairy and bearing numerous yellow flowers. A striking plant on some of the sandy slopes and draws in the Bitter Creek hills. Point of Rocks, June 1 (3074); Bitter Creek, June 2 (3098).

Oreocarya sp. (?).—Two small, white flowered-forms were collected, which are yet unnamed. Green River, June 1 (3072); Red Desert, June 3 (3121).

Oreocarya sp. (?) near *O. affinis* Greene.—An erect form, simple or branched from the base, 3 to 6 inches high. On the driest cliffs. Green River, May 30 (3035).

SCROPHULARIACEÆ.

Pentstemon fremontii T. & G. (Fremont's Beard-tongue).—One to several herbaceous stems from a short, woody rootstock, 3 to 6 inches high, root-leaves numerous, clustered, somewhat ashy colored. Bitter Creek plains, June 2 (3097).

Pentstemon arenicolus A. Nels. (Sand-dune Beard-tongue.—A very handsome plant, branched from the base, stems 4 to 8 inches high, and bearing a profusion of large, blue flowers. Point of Rocks, June 1 (3090).

Pentstemon jamesii Benth. (James's Beard-tongue).—Much branched from the base, only a few inches high, foliage pale or ashy. Green River, May 31 (3052).

Pentstemon radicosus A. Nels. (Tufted Beard-tongue).—An erect form, with slender stems, borne in great clusters from a compact mat of tough, slender roots, 6 to 9 inches high, leaves small and nearly uniform in size. Point of Rocks, June 1 (3089).

Pentstemon strictus Benth.—With long, tapering or wand-like erect stems, and a terminal spike of large, handsome flowers. South Butte, July 13 (3538).

Castilleja sp. (?).—A tall, slender form, much resembling *C. linearifolia* Benth.; rare, only a few specimens secured. South Butte, July 13 (3545).

Adenostegia ramosa Greene.—This small, much branched annual is remarkably abundant throughout the desert. Wamsutter, July 11 (3522).

PLANTAGINACEÆ.

Plantago eriopoda Torr. (Western Plantain).—This is rarely absent from wet alkali flats or creek banks.

COMPOSITÆ.

Coleosanthus microphyllus Kuntze.—A small plant from a woody base, from which arise numerous strict, slender branches, 5 to 10 inches high; the small leaves very numerous. Only a few specimens noted. The Gap, July 25 (3594).

Chrysothamnus collinus Greene (Hillside Rabbit-brush).—A small, much branched shrub, less than a foot high, stems and leaves yellowish-green. Eaten by sheep as a last resort. Point of Rocks, August 30 (4435).

Chrysothamnus linifolius Greene (Creek-bank Rabbit-brush).—A slender, willowy shrub, 2 to 3 feet, with bright-green linear-lanceolate leaves. It was observed only on the immediate banks of the strongly saline creeks, where it was very abundant. Granger, July 30 (4137): Rock Springs, July 30 (4143); Point of Rocks, August 30 (4440).

Chrysothamnus pumilus Nutt. (?).—A small shrub with shreddy bark, the new branches being light-colored or almost white, stems and leaves glabrous. branched and spreading, but rarely more than 12 to 18 inches high. Wamsutter, July 11 (3524).

Chrysothamnus speciosus Nutt. (?).—A rather stout, branched shrub, 3 feet or more in height, the new twigs slender, green or yellowish, bearing numerous long linear leaves. Differing from the other Rabbit-brushes of the region in that it does not form close clumps, but grows as single, conspicuous shrubs, branched above, thus simulating in habit a miniature tree. Creston, August 28 (4119).

Chrysothamnus stenophyllus Greene.—A small shrub, the older branches spreading, the younger somewhat fascicled and erect, white. It prefers sandy slopes and ridges. Point of Rocks, August 30 (4134). The forage value of the Rabbit-brushes is very small. Sheep men say that in emergencies sheep will crop the young branches and leaves, but that they leave this forage as soon as other feed is at hand.

Stenotus acaulis Nutt.—A plant with numerous naked stems each bearing a large head of yellow flowers. Leaves from the woody base slender and very numerous. Common on the clay and shaly slopes; Green River, May 30 (3022).

Petradoria pumila Greene.—Some seemingly nearly typical plants were secured at South Butte, July 13 (3551).

Townsendia strigosa Nutt.—Abundant on the white bluffs about Green River, May 30 (3031).

Aster adscendens Lindl.—The nearly simple, wand-like stems about a foot high, usually growing in clumps. Rare in the desert, only observed on the slopes below the winter snowdrifts. South Butte, July 13 (3553).

Machaeranthera sessiliflora Greene.—Infrequent. Creston, August 28 (4271).

Xylorrhiza parryi Greene.—Very abundant on clay slopes throughout the desert. Red Desert, June 3 (3123).

Erigeron condensatus Greene.—A small, spreading form, abundant in the hills near Point of Rocks, June 1 (3088).

Erigeron subtrinervis Rydb.—Occasionally in the thickets below the winter snowdrifts on the steeper slopes. South Butte, July 13 (3539).

Gnaphalium palustre Nutt.—A small spreading herb, scarcely 2 inches high; usually found in old buffalo wallows or in the loose soil of ditch banks. Creston, August 29 (4274).

Iva axillaris Pursh.—A weed-like plant, branching freely and becoming 6 to 9 inches high. It is very abundant on the low banks of Bitter Creek. July 12 (3525).

Balsamorhiza hirsuta Nutt.—Very rare, only a few plants secured. South Butte, July 13 (3552).

Hymenopappus luteus Nutt.—A very tomentose form, much branched, 3 to 6 inches high, was secured on the bluffs at Green River, May 31 (3051).

Tetraneuris lanata Greene.—A perennial plant with numerous root-leaves and naked stems bearing single yellow heads, 3 to 4 inches high. Excellent specimens were secured of this good species which until recently has been suppressed by merging it into *T. acaulis* Greene. Green River, May 31 (3068).

Tanacetum nuttallii T. and G. (NUTTALL'S TANSY).—A small, caespitose perennial producing little spherical heads of flowers on slender, naked stems, 2 to 3 inches long. Green River, June 1 (3049).

Artemisia cana Pursh. (WHITE-LEAFED SAGE-BRUSH).—A small shrub, 2 to 3 feet high, with slender branches and long, entire leaves, grayish-white in color. Of the sage-brushes this is the best forage plant. Creston, August 28 (4421); Hat Creek, August 20 (4250).

Artemisia pedatifida Nutt.—A low, matted sage occurring frequently on the alkaline flats and in the clayey draws. Though small and inconspicuous it probably furnishes considerable forage for sheep. Bitter Creek, June 2 (3103).

Artemisia spinescens Eaton (BUD BRUSH; SPINY SAGE-BRUSH).—Early in the spring this forms a low, spherical clump of tender leaves and flower buds that are much relished by sheep. Green River, May 30 (3028).

Artemisia trifida Nutt.—A small shrub with deeply three-cleft leaves, not common; principally in the hill region. Not sufficiently abundant to have any economic significance.

Artemisia tridentata Nutt. (COMMON SAGE-BRUSH).—The best known shrub of the great, arid West, varying immensely in size in different situations, from a dwarf shrub less than a foot high to almost tree-like proportions; common on the plains and at increasingly higher altitudes up to the subalpine parks of the mountains.

Artemisia sp. (?).—A small, almost herbaceous form with slender stems and numerous, entire leaves was found growing interspersed among the grasses in a wet draw among the hills. It may possibly be a form of *A. mexicana* Willd., but more probably is new. If it could be grown as a crop it looks as if it might have forage value.

Senecio canus Hook.—A perennial herb of no value as forage; in the draws at Green River, June 1 (3070).

Tetradymia canescens DC.—A closely branched shrub, 9 to 15 inches high, leaves and branches whitish with fine hair, producing dense clusters of yellow flowers. Probably eaten to some extent by sheep, the tender twigs in the winter, the young leaves and twigs in late spring. Bitter Creek, July 12 (3699); Point of Rocks, August 30 (4432).

Tetradymia canescens inermis Gray.—Very similar to the preceding, but smaller and more compactly branched. Bitter Creek, June 2 (3107).

Tetradymia nuttallii T. & G.—An intricately branched shrub, 1 to 3 feet high, less whitened with hair than the preceding, horridly prickly with rigid, sharp, divergent spines; the young branches soft and freely nipped off by sheep. Green River, May 31 (3061); Fort Steele, June 5 (3134); Bitter Creek, July 12 (3697).

Tetradymia spinosa H. & A. (see Pl. III, fig. 2).—More slender and less branched than the preceding, the branches perfectly white, with tomentum or matted wool; the leaves are dropped early in the season and the compact, naked mass of white twigs form a very conspicuous part of the vegetation on the otherwise often rather naked slopes and hills. Though the older stems are rather sharp-spiny, yet this forms a valuable constituent of the winter forage for sheep and antelope.

Carduus leiocephalus Heller.—A small thistle with white, woolly leaves; not abundant. Bitter Creek, July 12 (3529).

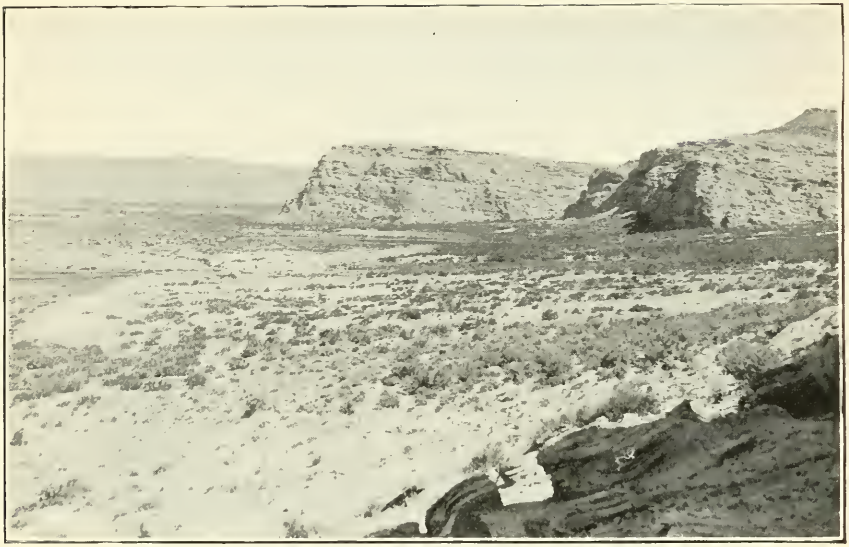


FIG. 1.—POINT OF ROCKS, BITTER CREEK VALLEY.

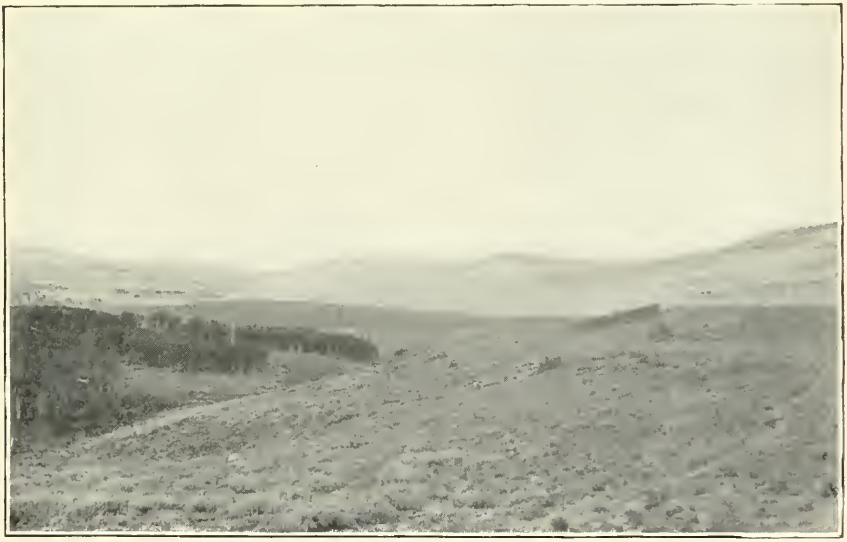


FIG. 2.—THE IDEAL SUMMER RANGE.

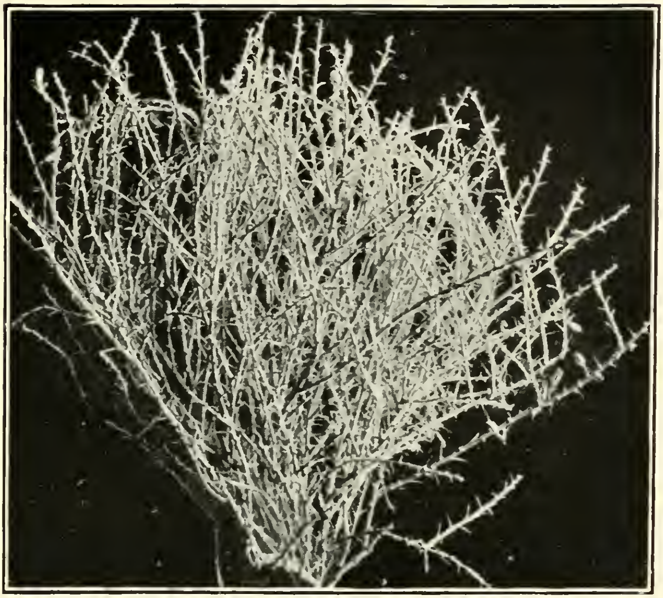


FIG. 1.—TETRADYMIA SPINOSA H. & A.

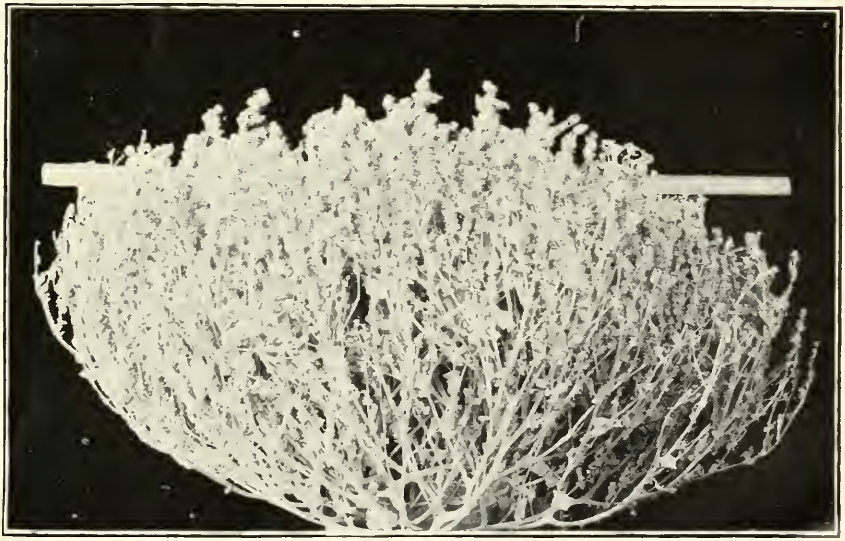
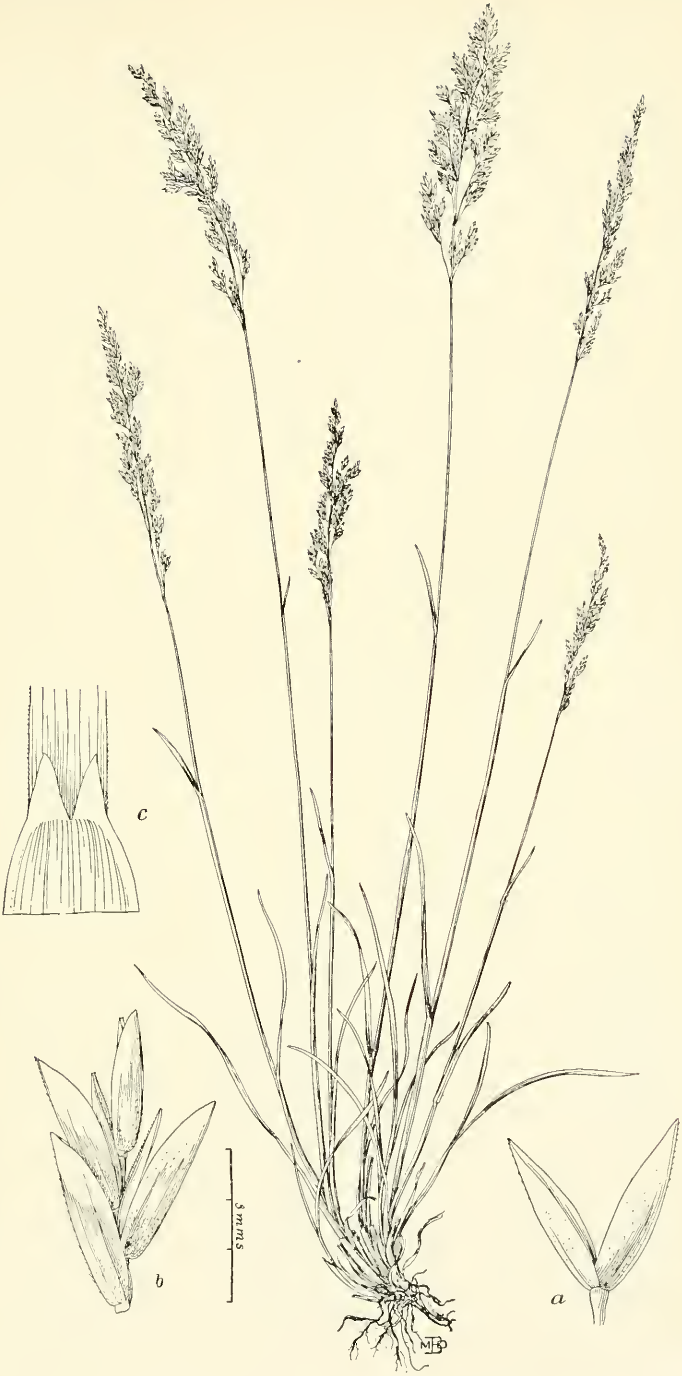
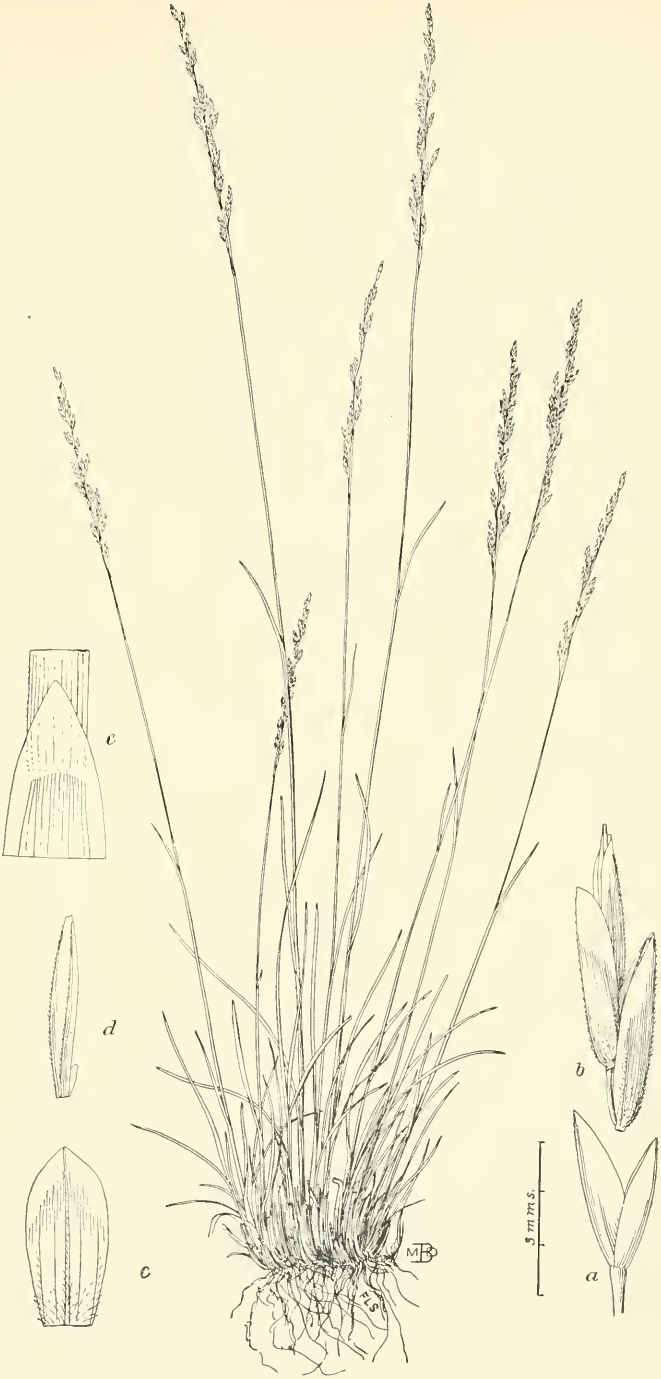


FIG. 2.—ATRIPLEX VOLUTANS A. Nels.



SHELDON'S BLUE-GRASS (POA SHELDONI Vasey).
a, Empty glumes; *b*, Florets; *c*, Ligule.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ALKALI BLUE-GRASS (POA JUNCIFOLIA Scribn.).

a, Empty glumes; *b*, Florets; *c*, Flowering glume; *d*, Palea; *e*, Ligule.

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BULLETIN No. 14. Agros. 34.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

ECONOMIC GRASSES.

BY

F. LAMSON-SCRIBNER,
AGROSTOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., June 29, 1898.

SIR: I have the honor to present and recommend for publication as Bulletin No. 14 of this Division manuscript containing brief descriptions of the more important economic grasses of this country or those which have been introduced because possessing some merit. This publication it is believed will afford a ready answer to the usual inquiries respecting a large number of our grasses. Much of the matter here presented is taken from Bulletin No. 3 of this Division, but owing to the fact that that bulletin exceeded 100 pages the edition published was limited to 1,000 copies, and consequently was very quickly exhausted. The matter has here been condensed in order that a larger edition may be published to meet the demands of correspondents.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

HON. JAMES WILSON,
Secretary of Agriculture.

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ECONOMIC GRASSES.

DESCRIPTIONS.

No. 1. Agropyron caninum (L.) R. & S. Bearded Wheat-grass.

A fibrous-rooted, rather slender, upright perennial, 2 to 3 feet high, with bearded, nodding heads or spikes resembling slender heads of wheat. This grass is more or less frequent in the northern parts of the United States, ranging from Maine westward to the Dakotas. Bearded Wheat-grass is closely related to the more common and better known Couch-grass (*A. repens*), but differs markedly from that species in having no creeping rootstocks, and in the longer beards or awns to the spikelets. No attempts have been made to introduce this grass into general cultivation, but its habit of growth and other characters indicate that it may possess considerable agricultural value. It is readily propagated by seeds, which may be easily gathered.

No. 2. Agropyron divergens Nees. Wire Bunch-grass.

A slender, usually densely tufted perennial, 1 to 2 feet high or more, with very narrow, spreading leaves, and bearded or beardless spikes. The beards or awns, when present, are widely spreading or divergent. This grass is common in the Rocky Mountain and Pacific Slope regions, extending westward to the coast. On rich lands it often grows to the height of 3 feet, but upon the dry bench lands it rarely exceeds a foot or 18 inches in height. On dry lands the stems become wiry with age, and are avoided by stock; but the grass is considered valuable by the ranchmen for winter grazing. Samples of this grass received from some points in the West, particularly from Washington, indicate that it possesses much agricultural value when grown upon good soil, and as it will thrive in the semiarid regions of the Northwest, its cultivation may prove desirable. Propagated readily by seed, which can be easily gathered.

No. 3. Agropyron pseudorepens Scribn. & Smith. Western Couch-grass.

A perennial, with creeping rootstocks, abundant in the northern prairie States, producing tall and leafy stems, which resemble those of Couch-grass, but are less wiry. This is less plentiful in the semiarid belt than the Western Wheat-grass or Colorado Blue-stem, but is better adapted for cultivation as a hay grass because of its softer stems and leaves. It is one of the most promising native species.

No. 4. Agropyron repens (L.) Beauv. Couch-grass. (Fig. 1.)

A grass abundant everywhere in the Eastern and Middle States, growing in the open fields, and in many places it has become one of the worst of weeds. Often the chief labor in managing hoed crops consists in subduing this pest. When once established, it is hardly less difficult to eradicate than the well-known Johnson-grass of the Southern States. It is, however, a valuable hay grass, and for two or three years the yield is large, but, like the Western Blue-stem, it "binds itself out," and the sod requires breaking in order to restore the yield. It is an excellent grass for binding railroad and other embankments subject to wash, and can be recommended for this purpose. The roots are well known in medicine under the name of *Radix graminis*. The simple infusion is used as a diuretic. Propagated by "root cuttings" or by seed.

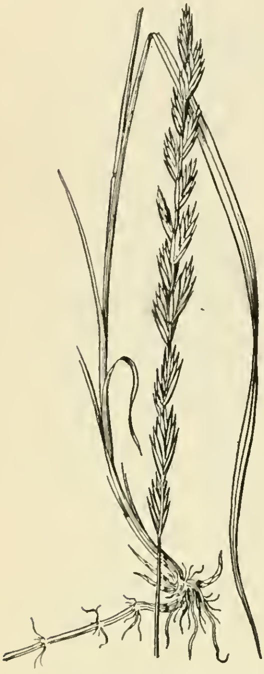


FIG. 1—Couch-grass (*Agropyron repens*).

No. 5. Agropyron spicatum (Pursh) Scribn. & Smith. Western Wheat-grass.

A grass closely resembling the Couch-grass of the Eastern States, and by some regarded as only a variety of it. It has the same strong and extensively creeping rootstocks, and the foliage and spikes are very similar, but the whole plant usually has a bluish color, whence the common name "Bluestem," most frequently applied to it in the West. It grows naturally on the dry bench lands and river bottoms; and, although the yield per acre is not large, the quality of the hay is unsurpassed by any other species of the region where it grows. In Montana and the neighboring States it furnishes a considerable amount of native hay, and is there regarded as one of the most important of the native forage plants. After three or four successive annual cuttings, the yield diminishes very much, but the grass is "brought up" by letting it stand a year or two, or by dragging over the sod a sharp-toothed harrow, thus breaking the roots into small pieces, every fragment of which makes a new plant. This grass is quite distinct from the "Blue-stem" grasses of Nebraska, which are species of *Andropogon* (*A. provincialis*). There are a number of other species of *Agropyron* or wheat-grasses in the Rocky Mountains, some of which are evidently excellent hay grasses and well deserve the attention of the agriculturist.

No. 6. Agropyron tenerum Vasey. Slender Wheat-grass.

A perennial bunch grass growing in the northern prairie region from Nebraska to Montana and Manitoba. Seed of this grass is now on the market, its sterling qualities for hay having long been recognized by Northwestern farmers. It produces an abundance of soft, leafy stems and root leaves, and ripens a large amount of seed that is easily gathered—two of the chief requisites of a good hay grass. This grass is well adapted for cultivation, and the area devoted to it is deservedly increasing each year.

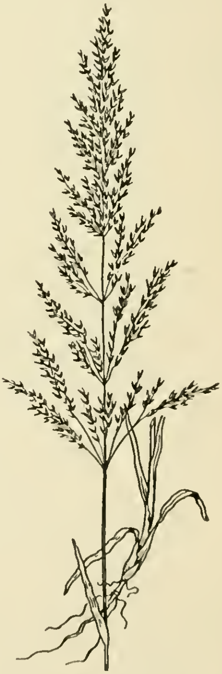


FIG. 2.—Redtop (*Agrostis alba*).

No. 7. Agrostis alba Linn. Redtop or Herd's-grass.

Under the botanical name of *Agrostis alba* are included a number of varieties, some of which have received distinct Latin names; as, for example, *Agrostis vulgaris* and *Agrostis stolonifera,* and many English or local names; that most generally applied in the Middle and Eastern States being Herd's-grass, and in the South and West, Redtop. The great variability of this grass has led to much diversity of opinion in regard to its value. The taller forms are largely cultivated for hay, being usually mixed with timothy and clover. This grass requires considerable moisture in the soil, and is one of the best for permanent pastures in the New England and Middle States. It makes a very resistant and leafy turf, which well withstands the trampling of stock. It grows well, also, as far south as Tennessee. Among the forms of low growth are two varieties which are unsurpassed, either in fineness or richness of color, for making lawns.

No. 8. Agrostis asperifolia Trin. Rough-leafed Bent.

This grass is common in the Rocky Mountain regions and on the Pacific Slope, growing chiefly in the mountain parks and along water courses. Its slender leafy culms are 2 to 3 feet high, and the narrow, pale-green, and densely flowered panicles 4 to 6 inches long. Judging from the appearance of this grass, it is likely to prove, under cultivation, superior to the Herd's-grass or Redtop of the East, at least for hay.

No. 9. Agrostis canina Linn. Rhode Island Bent.

This species of bent has been introduced into this country from Europe, and is cultivated to some extent in the Eastern States. It resembles Herd's-grass (Redtop) somewhat, but has shorter and narrower leaves. It makes a close sod, and is considered valuable for permanent meadows and pastures. It is one of the best grasses for lawns, and for this purpose should be sown at the rate of 3 to 4 bushels per acre. Retail price of seed quoted in New York catalogues, $2.75 per bushel.

No. 10. Agrostis coarctata (Reichb.) Ehrh. Sea-coast Bent.

A creeping perennial with slender culms, the upright branches 1 foot high, short and narrow flat leaves, and densely flowered panicles 2 to 4 inches long. It grows in damp soils and sands along the sea coast from Newfoundland to New Jersey, often occurring where constantly drenched by the flying salt spray. It is a fine-leafed, excellent turf-forming species, valuable for lawns. A similar if not identical species is common in western Oregon aud Washington.

No. 11. Agrostis exarata Trin. Northern Redtop.

The grass upon which this species was founded is a native of Alaska, but a number of forms which occur in the Rocky Mountain regions and on the Pacific Slope have been referred to it. Some of these have been characterized as distinct species, and there are several among them which, from their tall, leafy habit and vigorous growth, indicate the possession of considerable agricultural value, although none of them have as yet been introduced into cultivation. They are deserving of the attention of the agriculturist, and their culture is recommended, particularly on the Pacific Slope. They would doubtless thrive in the Eastern and Middle States, and possibly supplant, by their greater luxuriance and better qualities, some of the species now cultivated.

No. 12. Agrostis scabra Willd. Rough Bent.

A slender, erect, tufted annual, with numerous very narrow basal leaves, and delicate, widely spreading capillary panicles, which at maturity break away from the culm, and are blown about by the wind, hence one of the common names, "fly-away-grass." Before the panicle has fully expanded, this grass is sometimes gathered and sold under the name of "silk-grass" for dry bouquets. It is widely distributed throughout the United States, but is of little or no agricultural value. In irrigated meadows of the Northwest this species, or a form of it, is occasionally sufficiently abundant to furnish a large amount of hay which is regarded of good quality.

No. 13. Agrostis stolonifera Linn. Creeping Bent.

By some regarded as only a variety of *Agrostis alba,* with long, prostrate or creeping stems, well adapted for sandy pastures near the coast, and useful, perhaps, for binding shifting sands or river banks subject to wash or overflow. It makes a good pasture grass for low lands, especially for those which are somewhat sandy, and produces a fine and enduring turf for lawns, for which is is especially well adapted. It is not a productive hay grass, although it has a record of yielding on rich, peaty soil 7,742 pounds of hay and 2,722 pounds of green aftermath per acre. If sown alone, sow at the rate of 2 bushels per acre, or for lawns 3 bushels. Current retail price in New York, $3.50 per bushel.

No. 14. Agrostis vulgaris With. Herd's-grass; Redtop.

This is little more than a variety of *Agrostis alba,* already noted. It is quoted in the seed catalogues as a distinct species, and is recommended for mixtures designed for permanent pastures or meadows. It succeeds as far south as Tennessee, and is often sown with timothy and red clover. Retail price of seed, New York market, $1 to $1.50 per bushel.

No. 15. Alopecurus geniculatus Linn. Water Foxtail. (Fig. 3.)

A low, usually procumbent grass, with slender stems 8 to 18 inches long, often rooting at the lower joints. It usually grows in wet places, and is very widely distributed throughout the north temperate zone. It has cylindrical heads or panicles, resembling those of Meadow Foxtail, but much smaller. This grass enters into the natural herbage of low, wet meadows and pastures, and in such places affords excellent grazing, being tender and nutritious. *Alopecurus fulvus* is simply a variety of this, with short-awned flowering glumes. Under favorable circumstances this grass makes a good turf and a pleasing lawn of a deep rich green color, remaining green throughout the severe winter weather of the Middle States.

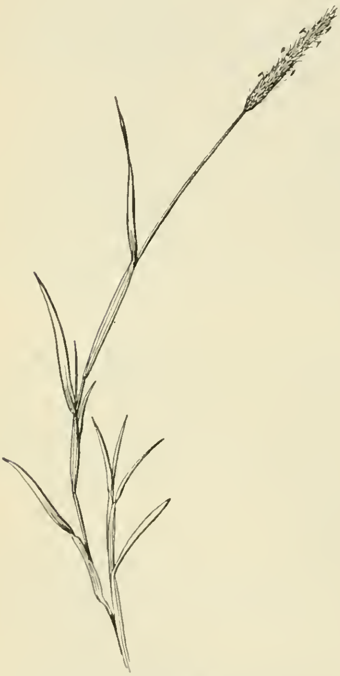


FIG. 3.—Water Foxtail (*Alopecurus geniculatus*).

No. 16. Alopecurus occidentalis Scribn. Mountain Foxtail.

A grass of the mountain meadows of the Rocky Mountains, growing in rich soil along streams and in the open parks. It has slender, erect stems 2 to 3 feet high, with short, oblong heads, thicker and shorter than those of common Meadow Foxtail. This grass is occasionally found covering extensive areas to the exclusion of other species. It yields a large bulk of fine, long, bright-colored hay, which is highly valued where it can be obtained. For the more elevated meadows of the Rocky Mountain region, and doubtless also for the New England and North Middle States, this grass would form an excellent addition to the cultivated species, and its introduction is recommended.

No. 17. Alopecurus pratensis Linn. Meadow Foxtail. (Fig. 4.)

This well-known European grass has been introduced into this country and cultivated to some extent in the New England and Middle States. It is a valuable grass for moist meadows and pastures, particularly the latter, on account of its

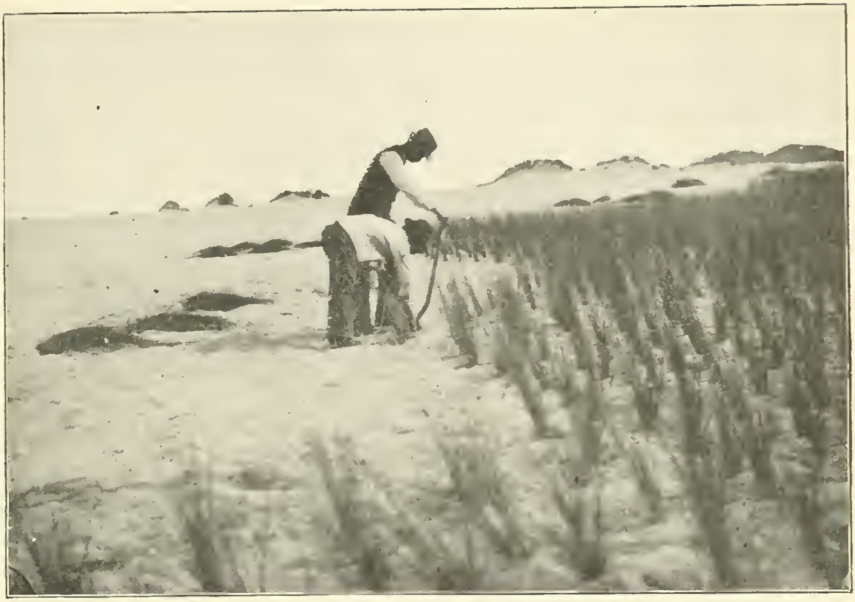


FIG. 1.—PLANTING BEACH GRASS IN SAND NEAR PROVINCETOWN, MASS.

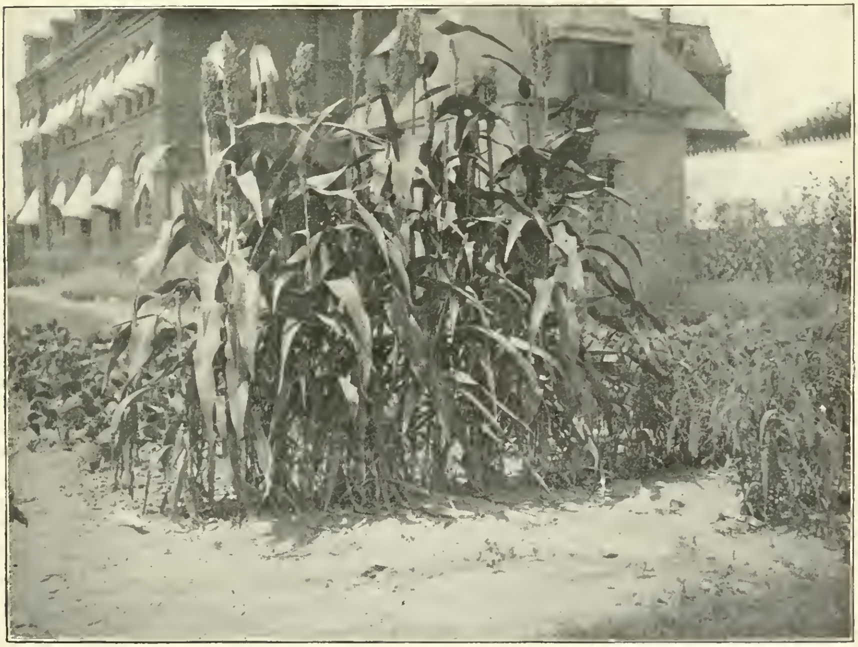


FIG. 2.—KAFIR CORN IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

early growth, being one of the earliest of the cultivated grasses. It is very hardy, and on good soil yields a large amount of excellent forage. In Europe it is regarded as one of the best perennial pasture grasses. It should enter into all mixtures for permanent pastures, because it is very lasting, highly nutritious, and earlier than most other species. This grass has a record of producing 20,418 pounds per acre of green grass, 6,125 pounds of hay, and 8,167 pounds of aftermath. It is never sown by itself, but is always mixed with other grasses and forage plants, because it gives a full yield only in the second or third year. Average number of seeds in a pound, 907,000. Price of seed quoted in New York catalogues, $2.30 per bushel, or $32 per 100 pounds.

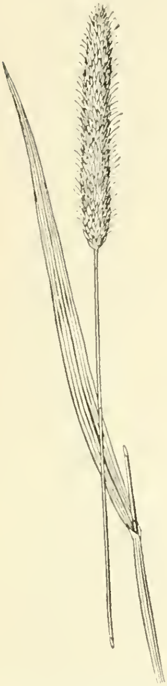


FIG. 4.—Meadow Foxtail (*Alopecurus pratensis*).

No. 18. Ammophila arenaria (Linn.) Link. Beach-grass. (Fig. 5.)

This grass grows more or less abundantly along the sandy coasts of the Atlantic and the shores of the Great Lakes. It has strong, creeping rootstocks, upright stems 2 to 4 feet high, and long, rather rigid leaves. The narrow, densely flowered panicles which terminate the stems are from 3 to 10 inches long. It is one of the most valuable grasses adapted to binding the drifting sands of our coasts, and has been cultivated for this purpose in this as well as in other countries. The action of this grass in holding the drifting sands is like that of brush or bushes cut and laid upon the ground in accumulating snow when drifted by the wind. The sand collects around the clumps of grass, and as it accumulates, the grass grows up and overtops it, and will so continue to grow, no matter how high the sand hill may rise. This process goes on over the whole surface of the plantation, and thus many acres may be raised far above their original level. A plant will, by gradual growth upwards, finally form stems and roots sanded in to the depth of fully 100 feet. Beach-grass is best propagated by transplanting (Pl. I, fig. 1). The grass is pulled by hand and planted 1 to 2 feet apart, according to the slope, by forcing a long spade or shovel into the sand, which is then carried forward, making an opening into which the roots are thrust, the spade then being withdrawn and the sand pressed close about them. The planting may be done either in the spring or fall, preferably in the fall. When propagation is by seed, the sowing should be done early in the spring and brush laid over the ground for holding the sand and seed temporarily in place. Beach-grass has been used for the manufacture of coarse paper, and it makes an excellent and very durable thatch. It is of no value for fodder.

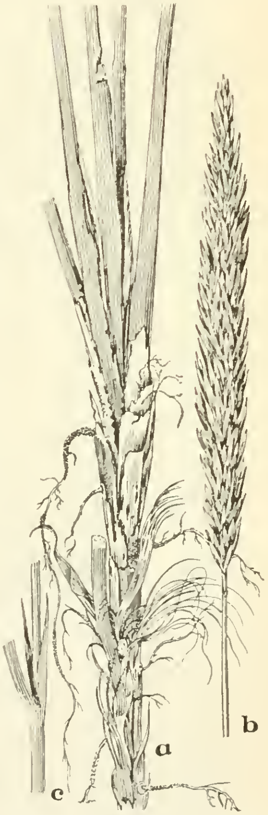


FIG. 5.—Beach-grass (*Ammophila arenaria*): *a*, base of culm; *b*, inflorescence; *c*, ligule.

No. 19. Andropogon contortus Linn. Twisted Beard-grass.

A stout, leafy perennial, 1 to 3 feet high, affording excellent grazing when young, but the mature seeds are much dreaded by sheep owners, as by their peculiar structure they not only become attached to and injure the wool, but often penetrate the skin and even the intestines of these animals. The strong rhizomes and tough fibrous roots which this grass has, commend it as a soil binder for river banks, dams, etc. The awns indicate by their twisting the amount of moisture in the air, and may be used as rain or fair weather indicators. In India this grass is used for thatching. It is a native of tropical and subtropical regions of both hemispheres, extending northward into western Texas, New Mexico, and Arizona.

No. 20. Andropogon glomeratus (Walt.) B. S. P. Brook-grass.

A stout perennial, 2 to 4 feet high, with dense, more or less elongated, broom-like panicles. It grows in low grounds and marshes from southern New York to Florida, also occurring in Mexico and Lower California. This species is esteemed a valuable pasture grass in the South. Its stems and leaves when young, are tender and juicy and are relished by stock of all kinds. Later the stems become tough and woody and are of less value.

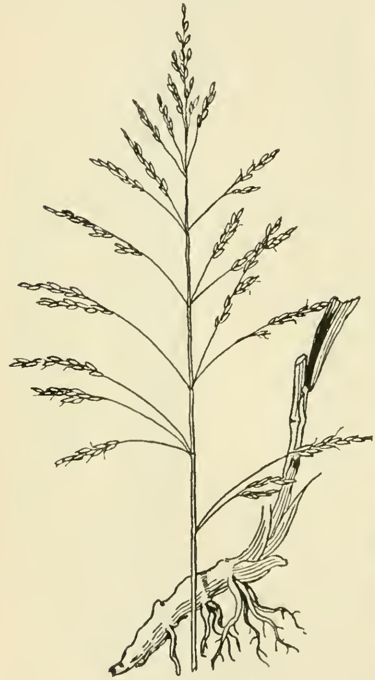


FIG. 6.—Johnson-grass (*Andropogon halepensis*).

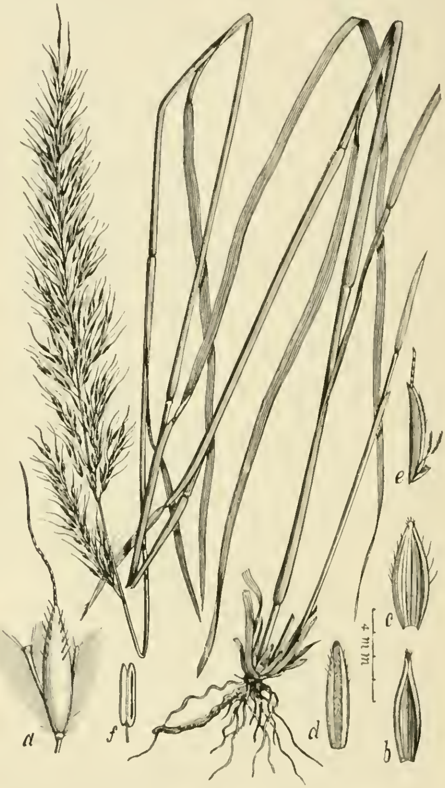


FIG. 7.—Bushy Blue-stem (*Andropogon nutans*): *a* to *f*, details of the spikelet.

No. 21. Andropogon halepensis (L.) Brot. Johnson-grass. (Fig. 6.)

A stout perennial, with smooth, erect culms, 3 to 6 feet high, and strong, creeping rootstocks. The panicles are expanded during flowering and are from 6 to 12 inches long. It is a native of southern Europe and the warmer parts of Asia and northern Africa. It was introduced into this country about sixty years ago, and has now become widely distributed and well known throughout the Southern

States. In the warmer parts of the Southern States it makes rapid growth, is but little affected by drought, and the hay, if cut just as the grass is coming into bloom, is much liked by all kinds of stock. Two or three cuttings may be made during the season. The extensively creeping rootstocks are fleshy and tender, and hogs are very fond of them. These roots literally fill the ground near the surface, and every joint is capable of developing a new stem. This grass, when once it has become established, is exceedingly difficult to eradicate, and hence has come to be greatly feared by the majority of farmers. Unless one wishes to give up his land entirely to Johnson-grass, and can certainly prevent its spreading to the lands of others, its introduction would be of doubtful economy, owing to its powerful and rapidly spreading roots. In India the natives make rude writing pens from the stems.

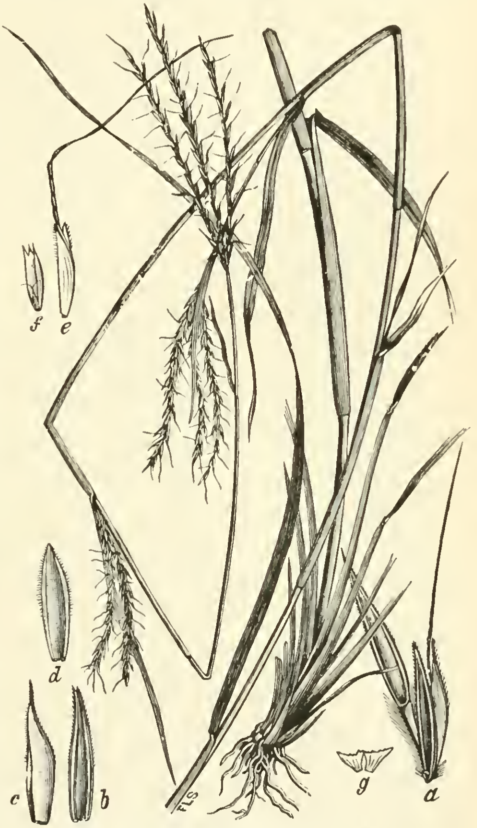


Fig. 8.—Big Blue-stem (*Andropogon provincialis*): *a* to *g*, details of the spikelet.

No. 22. Andropogon hallii Hack. Turkey-foot.

This is a stout grass, from 3 to 6 feet high, closely related to the Big Blue-stem (*Andropogon provincialis*), but appears to be confined to the sandy regions of the West. It is a good sand binder and is common in the sand hills of Nebraska, and extends southward into Texas. Its agricultural value is not known, but although more woody, it is probably nearly as valuable as Big Blue-stem.

No. 23. Andropogon nutans Linn. Bushy Blue-stem. (Fig. 7.)

This is a stout perennial, 4 to 6 feet high, growing in dry soil along the borders of fields and open woods, and on the prairies of the West it often forms a large proportion of the so-called prairie hay. It is held in little esteem in the Eastern and Southern States, but in the West it is said to make excellent hay, and is particularly valuable because of the relatively large amount of long root-leaves which it produces. All stock eat it greedily. In South Dakota it is given the first place among the native grasses as a hay-producing species, thriving best on the rich prairie bottoms. During the dry season it produces but little seed. though it usually makes a good growth of root leaves. In the middle Atlantic States this grass seeds freely and the seeds are easily collected.

No. 24. Andropogon provincialis Lam. Big Blue-stem. (Fig. 8.)

A stout perennial, with erect, more or less branching, and often bluish or glaucous stems, 2 to 6 feet high, long leaves, and flowers in short spikes, which stand two to five close together at the apex of the stem or its branches. These spikes are bluish or purple, sometimes pale green, and more or less hairy. This grass has a wide range, extending over the United States east of the Rocky Mountains, and in the West and Northwest, particularly in the Missouri region, it is very abundant, and is highly valued for hay. It grows in a great variety of soils, and under extremely varying conditions of climate, and enters largely into the composition of the hay of the prairies. The early growth consists of a great adundance of long leaves, and if cut in early bloom the hay is readily eaten by horses and cattle, but if allowed to fully mature the stems become hard and woody and the hay produced is of inferior quality. Investigations of the seed production of this *Andropogon* indicate that it matures seed rarely. It is stated that a very favorable season of moisture is required to make it fruit abundantly. This lack of fertility, if really true, will be a serious obstacle to the general propagation of the grass by the usual and convenient method of seeding.

No. 25. Andropogon saccharoides Swz. Feather Sedge-grass.

A variable grass, growing to the height of 1 to 3 feet, with narrow, silvery-bearded panicles. Some forms of this species have been introduced into cultivation for ornament. It is a native of our Southwestern States and Territories, in some of its varieties extending southward to Chile, where it is regarded as one of the best pasture grasses of the Cordilleras.

No. 26. Andropogon scoparius Michx. Little Blue-stem. (Fig. 9.)

A rather slender perennial, 1 to 3 feet high, more or less branched above; the slender racemes are single and terminate the culm or its branches. This grass has a similar range to the Big Blue-stem, extending over nearly all of the United States east of the Rocky Mountains, and in the prairie regions it is nearly always found associated more or less abundantly with the Big Blue-stem and Bushy Blue stem. It is common in the mountain districts of the South, and is valued there for grazing. In the West it is cut for hay, but is not so much thought of as the Big Blue-stem. In South Dakota this is one of the most common grasses in the basins of the Bad Lands.

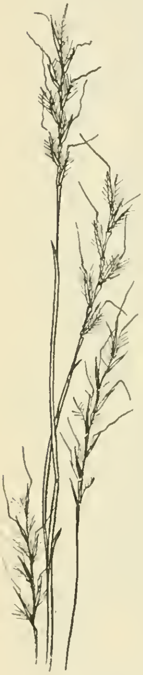


Fig. 9.—Little Blue-stem (*Andropogon scoparius*).

No. 27. Andropogon sorghum sativus Hack. Includes the cultivated varieties of sorghum.

Andropogon sorghum includes many varieties, a number of which have been recognized by some authors as distinct botanical species under the genus *Sorghum;* others, including Hackel, have referred them all to the genus *Andropogon.* Hackel has elaborately worked out the botanical characters of the species and characterized the known varieties, giving to each a technical name. It is not necessary here to follow out his classification, which is apparently good. In the works of others there is much confusion in the botanical classification, and still more in the application of the common or English names. The same name has been applied to different varieties and the same variety has often been designated under various names. All the forms are of Eastern origin, and have arisen probably from a common stock through ages of cultivation. From varieties of this species are obtained grain, which furnishes nutritious food for man and domestic animals, particularly poultry. Sirup and sugar in commercial quantities are obtained from the saccharine varieties. The variety *saccharatus*, or Chinese sugar-grass, yields about 13 per cent of sugar. Brooms and brushes, used in all civilized countries, are made from the inflorescence of the variety known as broom corn, and all furnish fodder of more or less value for farm stock. In Africa alcoholic drinks are prepared from the grains, and useful coloring pigments are contained in the fruiting glumes. The variety known as Kafir corn (Pl. I, fig. 2), which grows to the height of 4 or 6 feet, has been cultivated with great success as a fodder plant in the semiarid regions of the West. In fact, all the sorghums will grow in drier climates or under more trying conditions of drought than Indian corn. They may be cultivated in much the same way as that cereal, but the seed may be planted more thickly. In chicken corn or white Egyptian corn (var. *cernuum*) the densely flowered panicle is abruptly bent or recurved, so that it points downward. This variety is largely cultivated in tropical and northern Africa and in some parts of southern Asia, where it is used as a cereal. It is occasionally grown in this country, the seed being prized as food for poultry. The varieties adapted for the production of fodder or silage are particularly valuable for cultivation in the South and Southwest. The amount of fodder produced is often very large, of excellent quality, and there are few among the larger grasses better adapted for soiling. Yellow Milo Maize, White Milo Maize, and Jerusalem Corn, nonsaccharine varieties of *Andropogon sorghum*, are grown both for fodder and for the seed, particularly in the Southwestern States.

No. 28. Andropogon squarrosus. Linn. fil. Vetivert.

A stout perennial, 4 to 6 feet high, with strong, fibrous, and highly fragrant roots. A native of India, occurring also in some of the West India Islands and Brazil, growing in marshes and on river banks. Introduced into Louisiana many years ago, and now spontaneous in some of the lower parts of that State. Cultivated successfully at Knoxville, Tenn., where the fragrance of the rhizomes and roots was developed to a marked degree, but the plants did not bloom. In India this grass is largely used for thatching, and is woven into mats, which serve as screens or shades for doors and windows (tatties), awnings, covers for palanquins, and fans, and brushes used by weavers in arranging the thread of the web are made from either the roots or the whole plant. The roots, laid among clothing, impart a pleasing fragrance to the garments and are said to keep them free from insects. Fans made from the root fibers were among the articles on sale at the World's Fair in the Javanese bazaar. The roots are an article of commerce sold by druggists. In European drug stores the roots are known as *Radix anatheri* or *Radix vetiveriæ*, a stimulant or antiseptic. They yield a perfume known as *vetivert*, or, in India, *itar.*

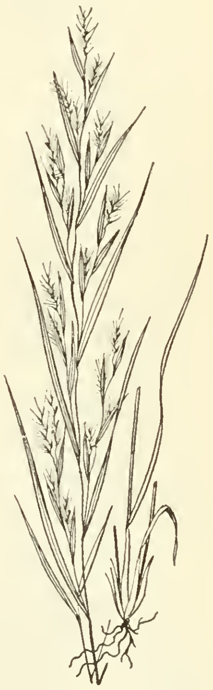


Fig. 10. — Broom Sedge (*Andropogon virginicus*).

No. 29. Andropogon virginicus Linn. Broom-sedge. (Fig. 10.)

A rigidly erect perennial, 2 to 4 feet high, bearing a narrow, elongated, and loosely-branched panicle of silky-bearded racemes. The stems are strongly flattened near the base, and at maturity they are too hard and woody to be eaten by stock or to be of any value for hay. When young, however, this grass affords most excellent grazing. Milch cows fed upon it are said to yield butter of superior quality. There is probably no native grass better known to the farmers of the South than this, and although possessing some value, as here indicated, it is, broadly speaking, one of the worst weeds of that section, interfering seriously with the formation of permanent meadows. Constant tillage or very close grazing appears to be the only means of keeping this grass from occupying the land.

No. 30. Anthoxanthum odoratum Linn. Sweet Vernal-grass. (Fig. 11.)

A perennial, early-flowering, sweet-scented grass, introduced into this country from Europe, and now widely distributed over the Eastern and Central States. It is an inferior fodder grass, but owing to its earliness it possesses some value in mixtures for pastures, and its sweet scent adds a pleasing fragrance to hay, of which it should form only a small percentage. The leaves have a bitter taste, and the grass is apparently unpalatable to stock, for they will not readily eat it. It is regarded as a serious pest in New Zealand. The stems have been used in the manufacture of imitation Leghorn hats. Average number of grains in 1 pound of pure seed, 924,000. Price of seed quoted in New York catalogues, $6 per bushel. Weight per bushel, about 10 pounds.

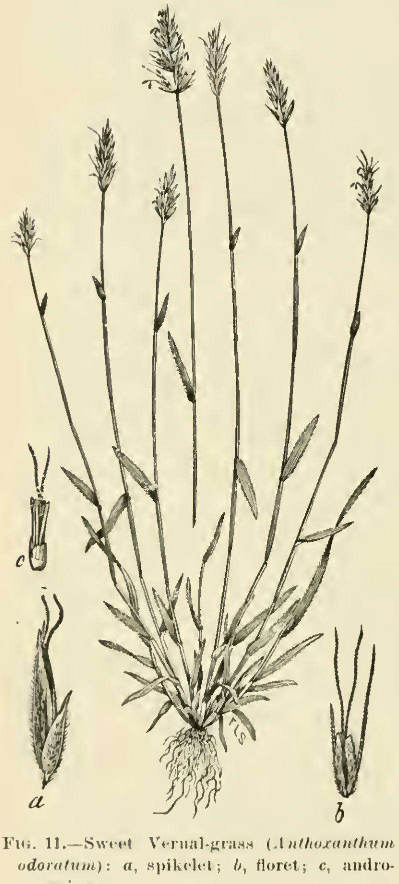


Fig. 11.—Sweet Vernal-grass (*Anthoxanthum odoratum*): *a*, spikelet; *b*, floret; *c*, androgynecium.

No. 31. Aristida fasciculata Torr. Needle-grass. (Fig. 12.)

Needle-grass grows from 6 inches to a foot high, and is a native of the arid regions, from Montana southward to Texas, where it is particularly abundant in poor soils, and presents a great variety of forms. It is usually found in dry, gravelly soils on the plains, mesas, and foothills. In the Eastern and Middle States the species of *Aristida* are deemed of little or no value, but in the Southwest, where every mouthful of fodder of any sort has value, they are not wholly worthless. *Aristida schiedeana* and *A. bromoides*, growing upon rocky and desert soil in Arizona and New Mexico, supply in their thin, scattered tufts "dainty bits seized upon by stock with avidity." (Pringle.)

No. 32. Aristida stricta Michx. Wire-grass.

This is one of the "wire-grasses" of the Southern States, growing to the height of 2 or 3 feet. The simple stems are terminated by a narrow panicle, usually a foot in length. It is common along dry, sandy ridges and in the pine barrens.

No. 33. Arrhenatherum elatius (L.) M. & K. Tall Oat-grass. (Fig. 13.)

A loosely tufted perennial, 2 to 4 feet high, introduced from Europe as a fodder grass and now quite generally distributed over the regions east of the Mississippi. In Europe it is regarded as one of the best meadow grasses, but is not recommended for pastures. It does well in the Southern States, where it is frequently cultivated, and is valued both for winter grazing and for hay. In California it is spoken of in the highest terms, particularly for its drought-resisting qualities. It does not form a very compact turf, and when sown should be mixed with other grasses. It grows rapidly, blooms early, and when cut dries out readily. It is not suited to heavy, moist soils, but thrives best on loamy sands or loams. It produces a large yield, and on good soils three or four cuttings may be obtained during the season. It is best sown in the spring, but in the Southern States it may be sown in September to advantage. In New Zealand this grass is spoken of as fast becoming a weed in mixed pastures; and, further, it is stated that the early growth is much relished by stock, but later in the season it is not touched. On rich, clayey loam this grass has made a yield of 17,015 pounds of green fodder, 6,380 pounds of hay, and 13,612 pounds of green aftermath per acre. When sown alone, the amount of seed to sow per acre is 5 to 6 bushels. Owing to the structure of the seed, it may be sown deeper than most other grasses. Average number of grains in one pound of pure seed, 159,000. Price of seed, quoted from New York catalogues, $3.25 per bushel, or $18 per 100 pounds.

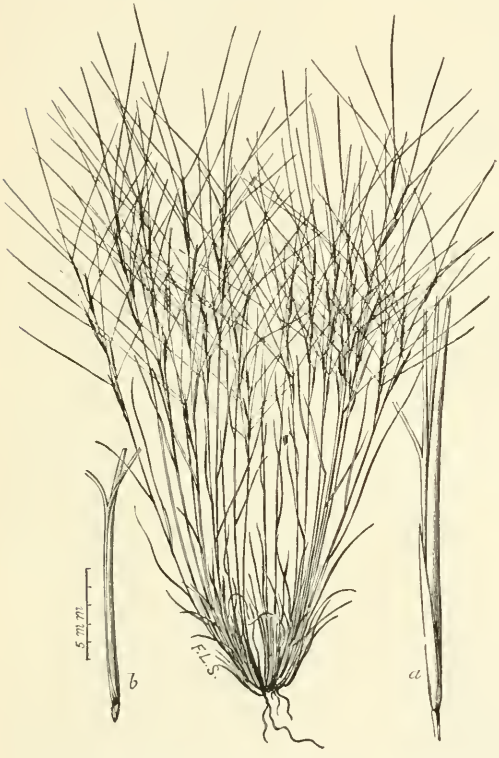


Fig. 12.—Needle-grass (*Aristida fasciculata*): *a*, spikelet; *b*, indurated flowering glume, the awns cut off.

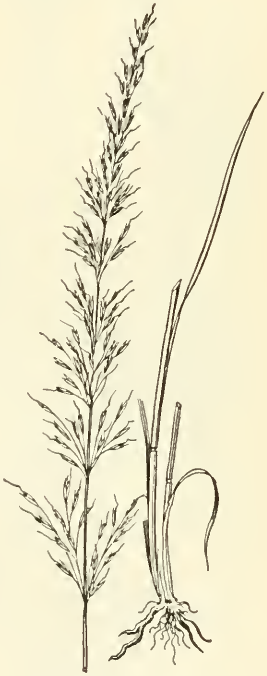


Fig. 13.—Tall Oat-grass (*Arrhenatherum elatius*).

No. 34. Arundinaria macrosperma Michx. Cane. (Fig. 14.)

This is the bamboo which forms the well-known canebrakes of the South. It is perennial, with woody stems 10 to 30 feet high, and evergreen leaves, which furnish a valuable supplement to the winter pastures. The plant blooms but once, and when the seeds mature the cane dies. The canes are used for many purposes, such as fishing rods, scaffolds for drying cotton, splints for baskets, mats, etc. Attempts made to cultivate this grass have not been successful.

No. 35. Arundinaria tecta (Walt.) Muhl. Small Cane.

This is regarded by some as only a variety of the cane mentioned above, but it is of smaller growth, rarely exceeding 10 feet in height, and extends as far north as Maryland. It forms extensive "canebrakes" in many parts of the Southern States, and its perennial leafage, together with the younger stems and branches, supply forage for thousands of cattle during the winter season. This fodder, however, does little more than sustain the life of the animals. It is of little or no value for fattening cattle or for milch cows.

No. 36. Arundo donax Linn. Reed.

A tall, leafy perennial, attaining the height of 10 to 15 feet, or in very favorable locations even 30 feet. The leaves are broad and widely spreading and the stems are leafy to near the top. The panicle has some resemblance to that of pampas grass, but is not so large. This grass is grown for lawn decoration and to conceal unsightly objects. It is a native of southern Europe, northern Africa, and western Asia, and is said to be spontaneous along the Rio Grande. In some countries the stout stems are used for laths and, when split, for woven work; the leaves are used for thatch or roofing, and the stout rhizomes are employed as a diuretic. A cultivated variety has its broad leaves striped with longitudinal white bands. It presents a very striking appearance. This grass is propagated by transplanting the roots, which work may be done at any time during the season. After growth has fairly commenced the subsequent development is very rapid, and for this reason it is one of the most important plants of its class for quickly producing scenic effects or for concealing unsightly objects.

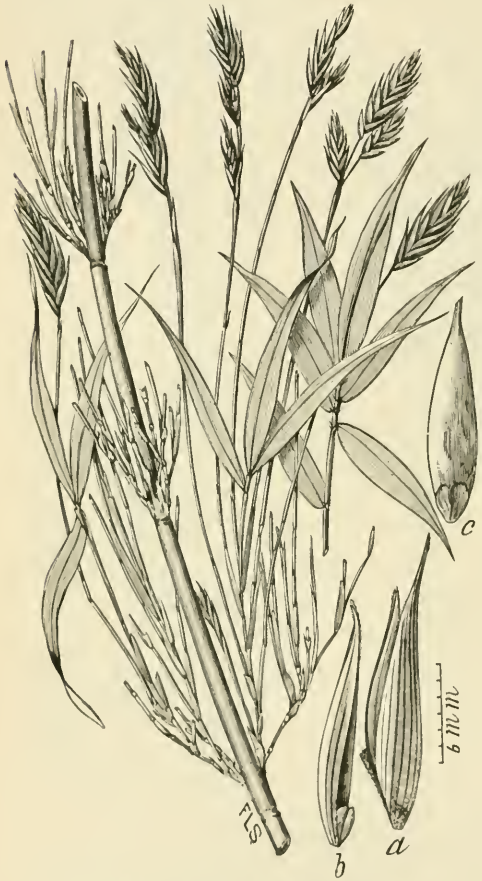


FIG. 14.—Cane (*Arundinaria macrosperma*): *a*, floret; *b*, palea and lodicules; *c*, grain.

No. 37. Astrebla pectinata F. v. Muell. Mitchell-grass.

A smooth, erect grass, 1½ to 3 feet high, with flat, long-pointed leaves and densely flowered terminal spikes or heads. It is a native of Australia, growing naturally upon the interior plains. It is regarded by the stockmen of that country as the best of all native grasses, both for its drought-enduring qualities and for its fattening properties. If cut just when coming into bloom, it makes excellent hay. The seed is produced in abundance, and is easily collected. This may prove a valuable grass for the semiarid districts of the Southwest. The seeds of this grass, as well as those of the closely related *Astrebla triticoides*, were formerly used as food by the natives of Australia.

No. 38. Avena americana Scribn. American Oat-grass.

In the grassy parks and on the foothills of the eastern slopes of the Rocky Mountains, this *Avena*, which closely resembles the *Avena pratensis* of Europe, is frequently found associated with the other native grasses. Where abundant it makes a valuable addition to the grazing resources of the country. It is deserving of a trial under cultivation.

No. 39. Avena fatua Linn. Wild-oats. (Fig. 15.)

An erect annual, 2 to 3 feet high, with loose, open panicles, 8 to 10 inches long, the whole aspect of the plant closely resembling forms of the cultivated oat. The spikelets are larger, however, and the flowering glumes are covered with long, brown hairs, and have a twisted awn an inch in length. It is a native of the Mediterranean region, but is now widely distributed over grain-growing countries, and with the closely related *A. barbata* Brot. is especially common in California and Oregon, and has spread eastward to Minnesota. It is of rare occurrence in the Eastern States. By some this is supposed to be the original of the cultivated oat (*Avena sativa*), which is said to readily degenerate into it. *Avena fatua* is in most places regarded as a troublesome weed. When abundant in the grain fields, it occupies the place of better plants, and reduces the grade of the thrashed grain by the admixture of its inferior and lighter seeds. The stiff and twisted awns are injurious to stock, as they frequently cause irritation of the nostrils and mouths of the cattle feeding upon them. In California the young plants, before the bearded or awned spikelets mature, are esteemed for grazing and forage. "The use of the Wild-oat, with its brown, hairy seed and twisted awn, as an artificial fly by fishermen, is well known, the uncoiling of the awn when wetted causing those contortions by which it imitates a fly in trouble." (Hooker.) A form of the Wild-oat with the flowering glume smooth (var. *glabrescens* Coss.) is quite widely distributed on the Pacific Slope, where it has become a most troublesome weed in wheat fields.

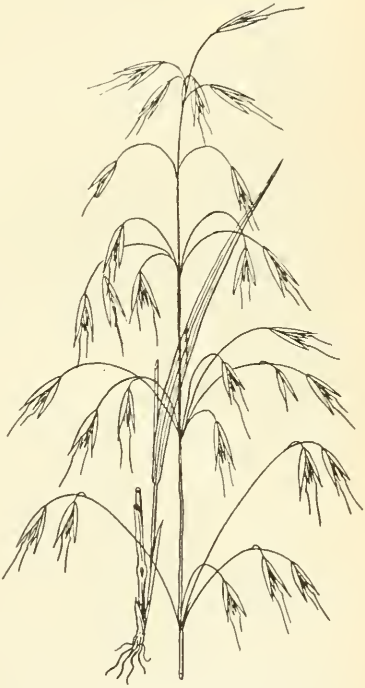


FIG. 15.—Wild Oats (*Avena fatua*).

No. 40. Avena pubescens Linn. Downy Oat-grass.

This grass is similar in habit and appearance to *Avena fatua*, but is much less common. It is a European grass, and has thence been introduced into this country. It is occasionally found in the grain region of the Pacific Slope. The soils best suited to the growth of this grass are sandy loams, upon which it is valuable for early mowing and pasturage Under favorable conditions it has produced 15,654 pounds of green fodder, or 5,870 pounds of hay, and 6,860 pounds of aftermath per acre.

No. 41. Avena sativa Linn. Oats.

A well-known erect annual, 2 to 4 feet high, with flat leaves and expanded panicles of rather large pendulous spikelets. There are many varieties, which have been divided into two classes, "panicle oats" with widely spreading panicle branches; and "banner oats" with the panicles somewhat contracted and one-sided. These two races are divided into "chaffy" and "naked-fruited" sorts; further varieties are established upon the color, form, or some special character of the grain. Oats have been cultivated from very early times in Europe, and they form the principal grain of such northern countries as Norway and Sweden, and Scotland, and in these countries boiled oatmeal and oatmeal cakes are important articles of food. Boiled oatmeal is also much used in this country, especially at breakfast. The grain, however, is principally cultivated here as food for horses. In the Southern States, oats, particularly winter oats, are largely grown for forage. Sown in August, they furnish the best grazing from October to the latter part of April, and will then yield a more certain and a larger crop of grain than spring-sown oats. They are often cut green for soiling and for hay. Oat hay is quite extensively used in the South and in California. The practice is to cut when the grain is in the "dough" stage, or when the straw commences to turn yellow below the head and the leaves are still green. The yield ranges from 3 to 4½ tons per acre, according to the variety and the season. The feeding value of oat hay is higher than that of timothy, containing about 8.8 per cent of crude protein, and 55 to 65 per cent of fat formers, while the latter (timothy) contains from 5 to 7 per cent crude protein, and 45 to 55 per cent fat formers. Among the cereals, oats are the most nutritious, but oaten flour lacks the gluten of wheat, rendering the making of bread from it impossible. Oatmeal is richer in nitrogenous matter than soft wheats, and contains more fat than any of the other grains. Russian "quas" beer is made from oats.

No. 42. Avena sterilis L. Animated Oats.

A stout, oat-like grass, with one-sided panicles, and very large, awned spikelets; the awn is very long, twisted, and "kneed" or geniculate. It is the twisting and untwisting of these awns when exposed to changes of moisture and dryness that has given to this grass the common name of "animated oats." The untwisting or coiling-up of the awn causes the spikelets to tumble about in various directions, suggestive of independent motion or life-like activity.

No. 43. Bambusa. Bamboo.

The bamboos belong to the *Bambuseæ*, a tribe of grasses numbering about 175 species, chiefly limited to South America, southern and eastern Asia, and the East Indies. There are no European species, and only two in North America (see *Arundinaria*). Of the whole number of species only one is common to both hemispheres. The largest bamboos attain a height of 120 feet, with a diameter of a foot or more. A South American species has leaves 3 to 12 inches wide and 5 to 15 feet long. In India are extensive bamboo forests, and in countries where these grasses abound they are employed for many purposes. They furnish material for the complete construction and furnishing (including domestic utensils) of houses. They are used in shipbuilding and in the construction of bridges. Buckets, pitchers, flasks, and cups are made from sections of the stems. Baskets, boxes, fans, hats, and jackets are made from split bamboo. Ropes and Chinese paper are made from these grasses. A Chinese umbrella consists of bamboo paper, with a bamboo handle and split bamboo for a frame. The leaves are used for packing, filling beds, etc., and occasionally serve as fodder for stock. The young shoots serve as a vegetable. Tabashir, or bamboo manna, a silicious and crystalline substance which occurs in the hollow stems of some bamboos, is regarded as possessing medicinal properties. Good drinking water collects in quantities in the hollows of the internodes of many of the larger bamboos. All sorts of agricultural implements, appliances for spinning cotton and wool or for reeling silk, are often constructed entirely from bamboo. Very many articles of household use or decoration made from bamboo have become articles of commerce in Europe and this country. So many and varied are the uses of the several species of bamboo, that it is possible to mention here only a small part of them. Bamboos are propagated by seed, but more often by cuttings. Plants from the seed do not attain a sufficient growth to admit cropping under 10 or 12 years.

No. 44. Beckmannia erucæformis (L.) Host. Slough-grass. (Fig. 16.)

A stout, erect, subaquatic perennial, 1 to 4 feet high, with narrow, densely flowered panicles. The leaves are broad and flat, and the stems are coarse but tender, becoming somewhat woody when old. It grows along the banks of streams and rivers and frequently follows the course of the irrigating ditches. When young, however, this grass is palatable and readily eaten by stock. In some portions of the Northwest, to which region this grass is confined in this country, it often occurs in such quantities as to constitute an important part of the forage of low pasture lands. It may be recognized by the peculiar, spike-like branches of the panicle, which have some resemblance to the rattles of a rattlesnake, and for this reason it is sometimes called "Rattlesnake-grass." It is deserving of trial under cultivation for low meadow lands in the more Northern States, and is especially adapted to irrigated alkaline lands.

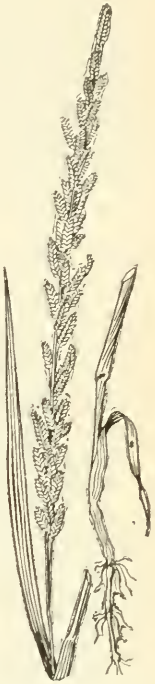


Fig. 16.—Slough-grass (*Beckmannia erucæformis*).

No. 45. Bouteloua curtipendula (Mx.) Torr. Side Oats. (Fig. 17.)

This is among the tallest of our species of *Bouteloua*, the rather stout, tufted stems being from 1 to 3 feet high. It has tough, perennial, fibrous roots, flat, long-pointed leaves, and many short spikes arranged along the upper portion of the stem. Its range extends from New Jersey westward to the Rocky Mountains and southward through Texas into Mexico. Where abundant, it is said to make fair hay, and the numerous root leaves afford good pasturage. The hay is readily eaten by stock, but on the range cattle show a decided preference for Blue Grama. Several species of Grama have been successfully grown in small cultures at some of the experiment stations, but none of them, although apparently most valuable as pasture grasses for the semiarid regions, have been introduced into general cultivation.

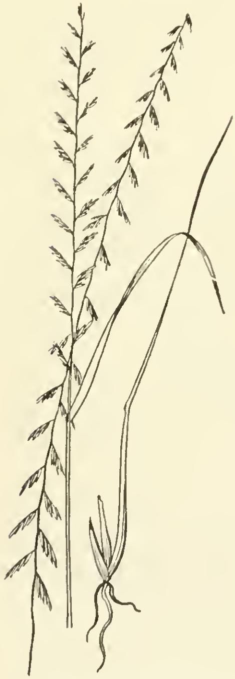


Fig. 17.—Side Oats (*Bouteloua curtipendula*).

No. 46. Bouteloua eriopoda Torr. Black Grama.

This is one of the species of Grama so valuable for grazing in New Mexico and Texas. The slender stems are 1 to 2 feet high, and from its thrifty habit of growth it forms dense and excellent pasturage wherever it grows abundantly. It is a common grass along the Rio Grande and in the region between the Pecos and the Gila; also in the Olympia, Guadalupe, and Eagle mountains, and on the Staked Plains in Texas. The woolly-jointed stems at once serve to distinguish this from the allied species of *Bouteloua*.

No. 47. Bouteloua oligostachya (Nutt.) Torr. Blue, or White Grama. (Fig. 18.)

This is one of the most abundant and most valued of the Grama grasses, and extends from Wisconsin westward to California, and southward into Texas and northern Mexico. It is a perennial, 6 to 18 inches high, its strong rhizomes and numerous root-leaves forming dense and more or less extensive patches of excellent turf. In Montana it is known as Buffalo-grass. It frequents the bench lands of that State, growing at elevations of from 3,000 to 4,000 or 5,000 feet, and not infrequently covers wide areas. No other grass better withstands the tramping of stock, and it is unsurpassed for grazing purposes. In the early days in the Southwest it formed a large proportion of the hay delivered at the various military posts and stage stations, and was considered the best obtainable there. Like the true Buffalo-grass, it cures during the dry season in the turf into perfect hay, losing none of its nutritious properties.

No. 48. Bouteloua polystachya Torr. Low Grama.

This is a small, slender grass, of good quality. It is one of the smallest of the Gramas, and only occurs sparingly here and there in scattered tufts. It rarely exceeds 6 inches in height, and is confined to the arid regions of the Southwest.

No. 49. Bouteloua repens (HBK.) Scribn. Creeping Grama.

A common grass in the vicinity of Acapulco, Mexico, where, according to Dr. E. Palmer, it occurs on the highest mountains and down their stony slopes to the water's edge. Greedily eaten by stock.

No. 50. Bouteloua texana Watson. (Seed Mesquit.)

This is a small but excellent grass, common about San Antonio and at other points in Texas, chiefly along the Rio Grande. It is recognized as an important grass in the stock ranges.

No. 51. Brachypodium japonicum Miq. Japanese Wheat-grass.

A promising Japanese perennial, closely resembling Bearded Wheat-grass (*Agropyron caninum*), but of rather stronger growth. It was introduced into California by the Agricultural Experiment Station of the University of California, at Berkeley, from New Zealand, in 1886, and the first seed was distributed in California in 1889. It has been cultivated with success at a number of points in California and at several of the experiment stations in the East. In the Southern States it is regarded as a valuable grass for winter grazing, as it makes its best growth during the cooler months.

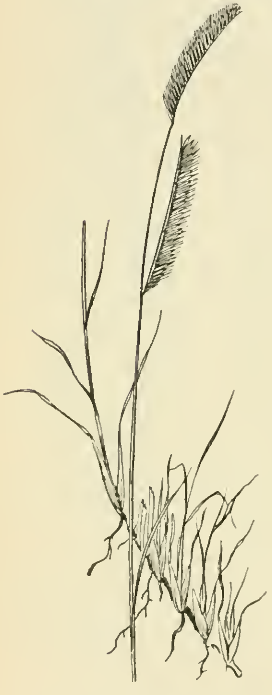


Fig. 18.—Blue, or White Grama (*Bouteloua oligostachya*).

No. 52. Briza media Linn. Small Quaking-grass. (Fig. 19.)

An erect perennial, from 1 to 2 feet high, introduced into this country from Europe because of its pleasing ornamental appearance. It has escaped from cultivation in many places, and has become sparingly naturalized. It is occasionally cultivated for ornament; the nodding panicles of rather showy spikelets are used for winter bouquets. It is but little known here, but is classed as a valuable meadow grass in Middle Europe and is recommended as an admixture for pastures on dry, thin soils. *Briza minor* is a smaller and more delicate annual species, also cultivated occasionally as an ornamental and for dry bouquets. *Briza maxima*, also an annual, is a larger ornamental species.

No. 53. Bromus ciliatus Linn. Swamp Chess.

A native perennial of wide range, frequent in open woodlands, growing to the height of 3 to 5 feet. It is leafy to the top, and would doubtless make a hay grass of good appearance, although of somewhat inferior quality. No attempts have been made to cultivate it for agricultural purposes. It makes a vigorous early growth on good soils and is recommended for propagation in wooded parks and woodland pastures.

No. 54. Bromus inermis Leyss. Smooth Brome-grass. (Fig. 20.)

An erect perennial, 2 to 5 feet high, with strong creeping rootstocks, and a loose open panicle, 4 to 6 inches long. A native of Europe introduced into this country by the Agricultural Experiment Station of the University of California about 1880, which gives considerable promise of value both for hay and pasturage. It is strongly stoloniferous, and quickly makes a thick, firm turf. It appears to grow with equal vigor in Canada and in Tennessee, remaining green throughout the winter season in the latter State. The strong perennial character of this Brome-grass and its unusual drought-resisting powers are qualities which recommend it for general cultivation, particularly in the semiarid regions of the West and Northwest. It thrives well on dry, loose soil, but of course the better the soil the greater the yield. Its nutritive value is comparatively low, and before undertaking its cultivation the fact should be remembered that it is somewhat difficult to eradicate when once established, although by no means so difficult as Couch-grass or Johnson-grass. In Europe it is classed among the best hay grasses. The seeds are quoted in New York catalogues at from $20 to $22 per 100 pounds. A bushel weighs about 14 pounds. Sow three bushels to the acre if sown alone. In this country the yield of seed per acre has been 600 pounds, which at the prices named would make it a very profitable crop. Professor Fletcher, of Canada, reports a yield of 3¾ tons of hay per acre.

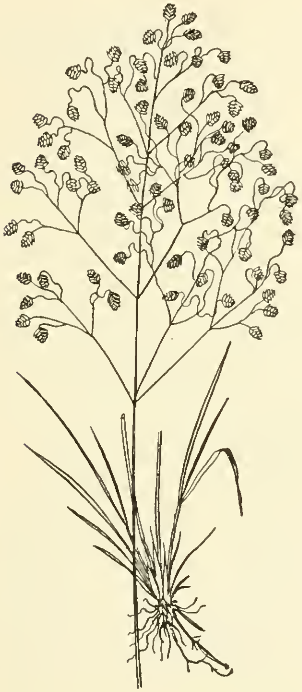


FIG. 19.—Small Quaking-grass (*Briza media*).

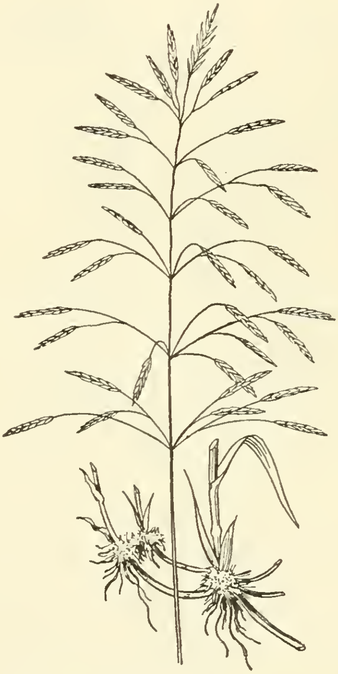


FIG. 20.—Smooth Brome-grass (*Bromus inermis*).

No. 55. Bromus pumpellianus Scribn. Western Brome-grass.

A native of the Northwestern States in the Rocky Mountain region, extending into Canada. In habit of growth it closely resembles Hungarian, or Smooth Brome-grass (*B. inermis*). and is doubtless equally valuable. Prof. James Fletcher, who has cultivated this grass at the experiment station at Ottawa, Canada, says, "This is a very valuable grass, producing an abundance of leaves, continuing in flower for a long time, and giving a heavy aftermath."

No. 56. Bromus racemosus Linn. Upright Chess.

An introduced annual, 1 to 3 feet high, with more or less spreading and nodding panicles and smooth spikelets. This is a very common grass in cultivated fields and waste places, and is often mistaken for Chess, from which it differs chiefly in its narrower panicles and straight awns, which are nearly as long as the flowering glumes. This grass has become very common in certain sections, particularly in the South. A field of it presents an attractive appearance, and the hay produced is of good quality.

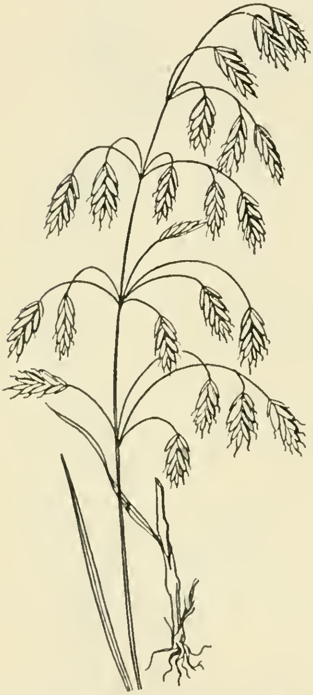


FIG. 21.—Chess (*Bromus secalinus*).

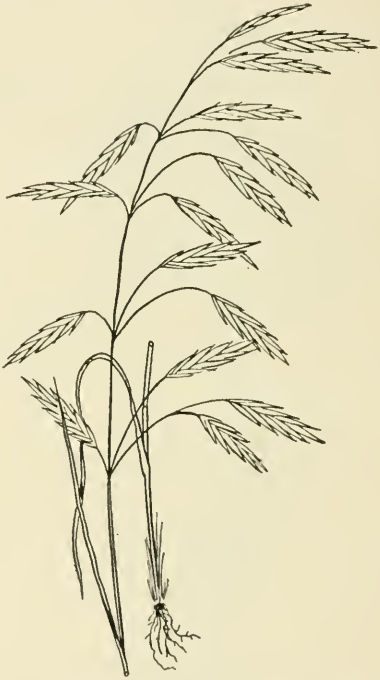


FIG. 22.—Rescue-grass (*Bromus unioloides*).

No. 57. Bromus secalinus Linn. Chess; Cheat. (Fig. 21.)

A well-known, weedy, annual grass, introduced into this country many years ago, and now common in grain fields and waste lands. The panicle is spreading and more or less drooping, and the awns of the flowering glumes are usually much shorter than the glumes themselves and more or less flexuose. The idea that Cheat or Chess is degenerated wheat has no foundation whatever in fact. Only Cheat seeds will produce Cheat, and it is certain that wherever these plants appear they were preceded by Cheat seeds, which may have been introduced with the grain sown, or brought by birds or animals from other fields. Cheat and wheat are only remotely related; they belong to quite distinct tribes in the grass family; wheat is less likely to change into cheat in a single generation than into the more nearly allied oats, or than wheat is to change into barley, with which it is very closely related.

No. 58. Bromus unioloides Willd. Rescue-grass. (Fig. 22.)

This *Bromus*, which is a native of South America, and probably also of the extreme southwestern portion of the United States, is a strong-growing grass, with rather broad, much flattened, usually bearded spikelets. It grows to the height of 1 to 3 feet, and in the more vigorous plants the branches of the nodding panicle are widely spreading. It grows rapidly, seeds freely, and dies after seeding. If, by frequent mowing or close grazing, it is prevented from going to seed, its duration may be continued over two or three years or more. If the seeds are allowed to fall, as they frequently do when mature, young plants soon appear, and a fairly continuous growth of this grass may thus be maintained. In many parts of the Southern States, where it has been most cultivated, it has come to be regarded as one of the best winter grasses, as it makes its chief growth during the cooler months of the year. Sow in August or September, at the rate of 30 to 40 pounds to the acre.

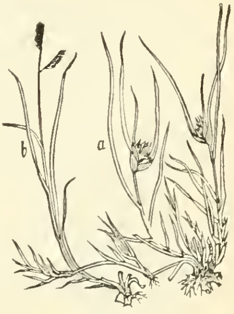


FIG. 23.—Buffalo-grass (*Bulbilis dactyloides*). *a*, female plant; *b*, male plant.

No. 59 Bulbilis dactyloides (Nutt.) Rafin. Buffalo-grass. (Fig. 23.)

This is the true Buffalo-grass of the Great Plains region, which is reported to have been much more abundant and more widely distributed in times past than it is at present. Now, however, it is known to extend from the British Possessions southward into Texas, where it is considered an invaluable grass and one of the best constituents of sheep pastures. It has a low habit of growth, rarely more than 5 or 6 inches high, and produces numerous creeping and widely spreading branches or stolons, which root at the joints, each joint forming a new tuft, and in this way the grass often covers large areas with a close mat of fine-leafed herbage, which is greatly relished by all grazing animals. As a winter forage, it is without an equal. The habit of growth of this plant is very similar to that of Bermuda-grass, but the stems and leaves are much finer and the turf formed more compact. Live roots transplanted from Nebraska to the grounds of the Department of Agriculture at Washington, D. C., have grown with remarkable vigor, and it may be possible to utilize this most palatable and nutritious grass in portions of the Eastern or Southern States.

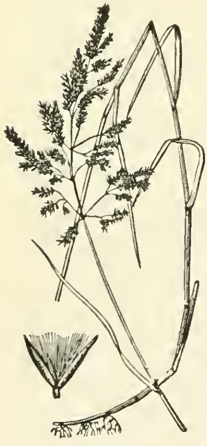


FIG. 24.—Blue-joint (*Calamagrostis canadensis*).

No. 60. Calamagrostis canadensis (Michx.) Beauv. Blue-joint. (Fig. 24.)

A native grass common in the Northern and Northwestern States, extending clear across the continent, usually growing in moist meadows. The leafy stems are 3 to 5 feet high, and the open brown or purplish panicles have some resemblance to those of Redtop. Occasionally it is found occupying considerable areas to the exclusion of other grasses, and under such conditions it yields a large amount of excellent hay, highly prized by farmers and eaten with avidity by all farm stock. This grass grows naturally on low, moist meadows, and has succeeded well under cultivation. In the northern portion of the United States its more extended culture for hay is recommended.

No. 61. Calamagrostis cinnoides (Muhl.) Spreng. Reed Bent-grass.

A stout, reed-like grass, 3 to 5 feet high, not infrequent in low, moist grounds and swamps, ranging from New England southward to Tennessee. No attempts have been made to cultivate it, and little is known of its agricultural value. Probably of some use for low woodlands where grasses are desired for pasturage, and if it will thrive in the open it would make a most excellent hay-grass for low meadows.

No. 62. Calamagrostis hyperborea americana (Vasey) Kearn. Yellow-top.

A very common grass in low meadows and shady river banks throughout the Northwest. It affords a large amount of excellent hay if cut in proper season. A good grass for cultivation in moist, sandy meadows.

No. 63. Calamagrostis neglecta (Ehrh.) Gaertn. Pony-grass.

A rather slender, erect perennial, with narrow leaves, and a contracted, densely flowered, brownish panicle, 3 to 6 inches long. A native of Northern Europe and North America, ranging along our northern borders from Newfoundland and Maine to the Pacific, being most abundant in the Rocky Mountain region. Under experimental cultivation it has succeeded well. It is a productive grass, much liked by stock, especially horses, and is deserving a place among the cultivated species.

No. 64. Calamagrostis suksdorfii Scribn. Pine-grass.

A rather slender, erect grass, 2 to 3 feet high, with smooth stems, narrow leaves, and contracted, usually pale, straw-colored panicles. A common grass in the Northwest, growing in low pine woods or on moist mountain slopes. It is said to be one of the most common grasses in Washington, and it presents all the qualities of an excellent hay or pasture grass.

No. 65. Calamovilfa longifolia (Hook) Scribn. Sand-grass. (Fig. 25.)

A stout, long-leafed grass, 1 to 4 feet high, growing in sands or sandy soil along the shores of the Great Lakes and in the Missouri region of the West, extending southward to Kansas. Its very strong and far-reaching rhizomes or creeping "roots" make this an exceedingly valuable grass for binding drifting sands, or those subject to wash by swift currents or the beating of the waves. As a sand binder for interior regions of the country this grass is probably unsurpassed. Its long, tough leaves suggest a possible value for paper making.

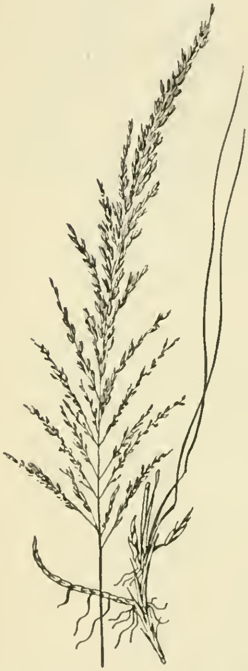


FIG. 25.—Sand-grass (*Calamovilfa longifolia*).

No. 66. Campulosus aromaticus (Walt.) Scribn. Toothache-grass. (Fig. 26.)

A perennial grass with erect stems 3 to 4 feet high. Native of the Southern States from Virginia southward, growing in the wet pine barrens, possessing no agricultural value, but rather curious in appearance. The strong rootstocks are lemon-scented and have a pungent taste.

No. 67. Cenchrus echinatus Linn. Cock-spur.

A rather stout annual, with branching culms 1 to 2 feet long, and dense heads or spikes made up of 20 or more globular, spiny burs containing the spikelets. It is a weed of the fields and waste places of the Southern and Southwestern States.

No. 68. Cenchrus tribuloides Linn. Sand-bur. (Fig. 27.)

A widely distributed grass growing in sandy soils along river banks, the seashore and more or less scattered throughout the interior of the country in sandy districts. It is one of the worst of annual weeds wherever it becomes abundant. The prostrate branching stems are 1 to 2 feet long; the spikes are composed of 10 to 15 strongly spiny burs, which readily become detached and adhere to passing objects. No pains should be spared in efforts to exterminate this grass wherever it makes its appearance.

No. 69. Chætochloa glauca (Linn.) Scribn. Yellow Foxtail. (Fig. 28.)

An erect annual, 1 to 2 feet high, with flat leaves, and a bristly, cylindrical, spike-like, densely flowered panicle 1 to 3 inches long. This grass is widely distributed throughout the tropical and warmer temperate regions of the world, growing as a weed in cultivated grounds. It is especially common in the Southern States, where it continues to bloom throughout the season, from June to October. It is distinguished from *Setaria viridis* by its somewhat larger spikelets and more widely spreading yellowish bristles.

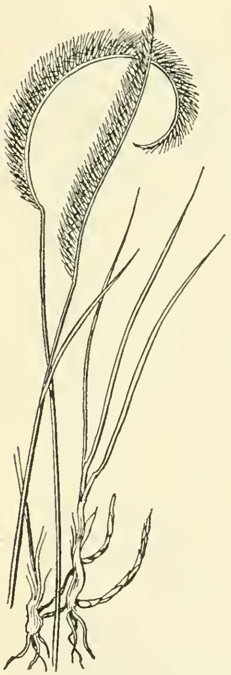


FIG. 26. — Toothache-grass (*Campulosus aromaticus*).

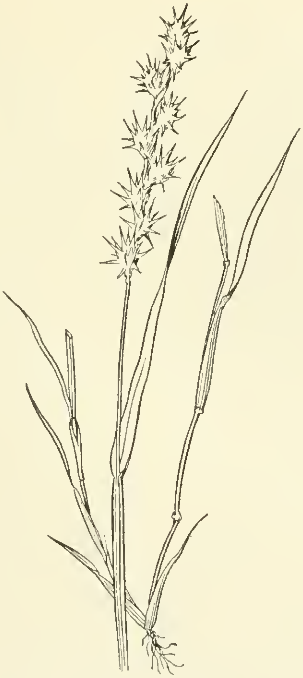


FIG. 27.—Sand-bur (*Cenchrus tribuloides*).

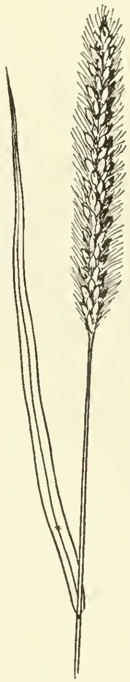


FIG. 28. —Yellow Foxtail (*Chætochloa glauca*).

No. 70. Chætochloa italica (Linn.) Scribn. Millet; Hungarian-grass. (Fig. 30.)

This grass, in some of its varieties, has been cultivated in the East for many centuries, and in some parts of India and Trans-Caucasia it still forms an important article of food. Its culture extends back to an early date in Egypt, and in the lake dwellings of the stone age it is found in such quantities that it must be regarded as the main bread supply of the prehistoric peoples (Hackel). In Europe and in this country it is cultivated to some extent for fodder and for the seed, the latter being used chiefly for fowls. It grows rapidly, and may be cut within sixty or sixty-five days from the time of sowing. If used for fodder, it should be cut just as it begins to head, before blooming, for when more advanced it is apt to be injurious to stock fed upon it. When cut in good season it is one of the most valuable of soiling plants. German Millet, *Chætochloa germanica* (fig. 29), is only a variety of *Chætochloa italica*, distinguished by its smaller, more compact, and erect heads, the bristles of which are usually purplish. Sow 2 to 3 pecks per acre for hay. One peck is sufficient when sown for seed.

No. 71. Chætochloa magna (Griesb.) Scribn. Giant Millet. (Pl. II.)

This native millet grows in swamps along the coast from Florida to Delaware. The leaves are very broad and long, and the stems are often 8 or 10 feet in height. It is one of the most promising grasses for use in the reclamation of swampy lands along the coast. It has been grown successfully in the grass garden on the Department grounds. A single plant, with much branched stems, is shown in Pl. II.

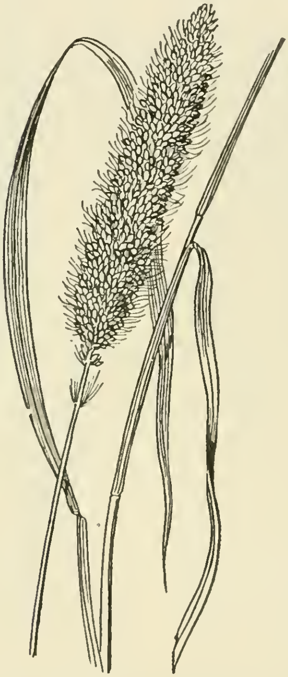


Fig. 29.—German Millet (*Chætochloa germanica*).

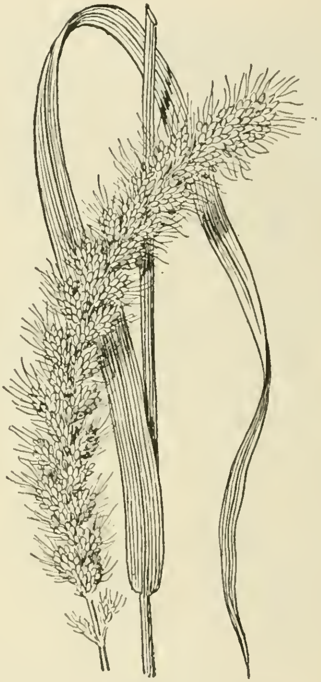


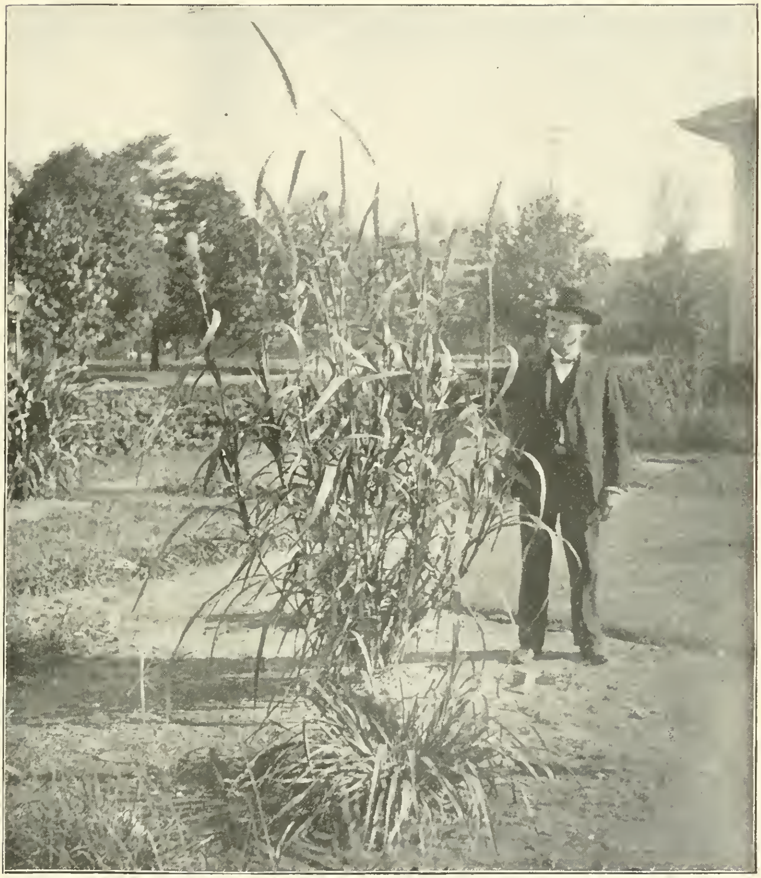
Fig. 30.—Millet (*Chætochloa italica*).

No. 72. Chætochloa verticillata (Linn.) Scribn. Bristly Foxtail.

Has about the same wide distribution as *Chætochloa glauca*, but is much less common in the United States. It is rarely found except in waste town lots and about dwellings in the Atlantic States. The bristles in this species are barbed downward, on account of which the "heads" cling to clothing or other objects with which they may come in contact. A weed.

No. 73. Chætochloa viridis (Linn.) Scribn. Green Foxtail.

Similar in habit to *Chætochloa glauca*, with about the same distribution, and equally common in this country, appearing as a weed in all cultivated grounds. It



SINGLE PLANT OF NATIVE "GIANT MILLET" IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

begins to bloom a little earlier than the Yellow Foxtail, the more numerous spikelets are smaller, the head or panicle less erect, and the bristles usually green, not yellow, as in that species. The stems are very tough and may be utilized for making paper.

No. 74. Chloris barbata Sw. Bearded Crowfoot.

This and the very similar *C. elegans* of our Southwestern States and Territories are pleasing ornamental grasses, growing to the height of 1 to 2 feet, the main stem and branches being terminated by 3 to 10 bearded spikes, which impart to them a striking appearance and make them valuable ornamentals. *C. polydactyla*, a West Indian species which has been found in southern Florida, is equally attractive, and has longer and more graceful spikes. *C. barbata* appears to be the only one generally cultivated, but there are several native species which are quite as ornamental. *C. gracilis*, a native of Central America and Mexico, is another species occasionally cultivated for ornament.

No. 75. Chloris glauca (Chapm.) Vasey. Smooth Chloris. (Fig. 31.)

A strong-growing grass, with diffusely spreading and ascending stems, 2 to 4 feet long, bearing 10 to 25 slender terminal spikes. Native of Florida, growing on brackish marshes and along the borders of cypress swamps. This is a handsome species, well deserving the attention of the florist and although not at present recognized as possessing any agricultural value, it produces a large amount of comparatively tender herbage and may prove to be a desirable fodder plant for certain localities along the Gulf coast. It has made a good growth under cultivation on clayey soil at Washington, D. C.

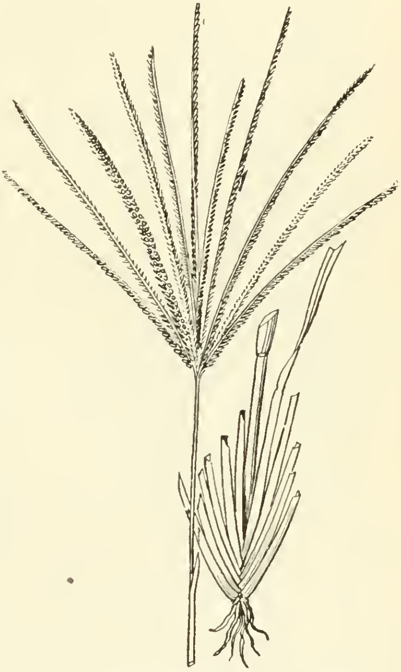


Fig. 31.—Smooth Chloris (*Chloris glauca*).

No. 76. Chloris verticillata Nutt. Windmill-grass.

A low, spreading perennial, with upright flowering branches 6 to 20 inches high. The small awned spikelets are in slender spikes, which are crowded near the apex of the stems, and become widely-spreading at maturity. This grass is common in many places in central Texas, New Mexico, Arizona, northward to Kansas, and by some is spoken of very highly as an excellent grass for grazing, and one not easily tramped out. The arrangement of the spikes gives the grass an odd and somewhat pleasing appearance, making it of some use as an ornamental species for gardens. It is a good turf-former.

No. 77. Cinna arundinacea Linn. Indian Reed.

A tall, leafy grass, 3 to 7 feet high, native and frequent in shaded swamps and damp woods or along streams in wet meadows. For such places it may possess some agricultural value, as it yields a large amount of excellent hay where growing abundantly.

No. 78. Coix lacryma-jobi Linn. Job's Tears.

This grass is a native of southern Asia, and is occasionally cultivated in this country for ornament or as a curiosity. It is cultivated for food by some of the hill tribes of India, and supplies a staple article of diet of the Tankhul Nagas of Manipur. The female flowers of this grass are inclosed in a nearly globular, capsule-like covering, which is very hard and becomes nearly white with age. In some countries these capsules are used for dress ornamentation and by the Catholics for rosaries. In China this grass is cultivated to some extent, because the fruit is believed to be valuable as a diuretic and antiphthisis. It is a hardy annual, 2 to 3 feet high, with broad leaves and a curious, nodding inflorescence. The "seeds" may be obtained from any of the leading seedsmen.

No. 79. Cynodon dactylon Pers. Bermuda-grass. (Fig. 32.)

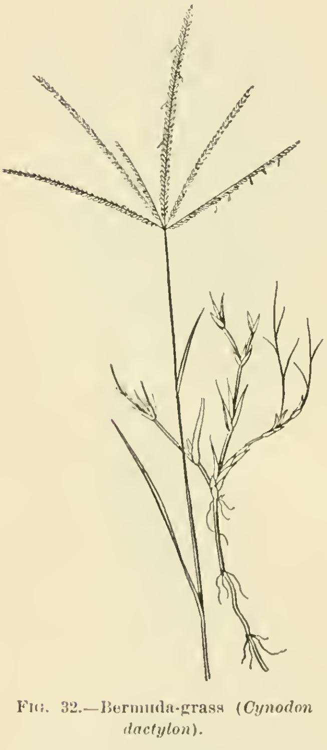


Fig. 32.—Bermuda-grass (*Cynodon dactylon*).

A grass widely dispersed over the tropical regions and warmer countries of the globe. It has a creeping habit of growth, extending over the surface of the ground and rooting at the joints. In poor soils the leaves are short and the upright flowering stems are only a few inches high, but on good land it grows to the height of 1 to 2 feet and yields a large amount of excellent hay. It may be cut three or four times during the season. In the Northern States it does not afford a profitable crop and is of little value for pasturage north of Virginia, but in the Southern States and in the warmer regions of the Southwest and on the Pacific slope it is cultivated extensively and is most highly prized, chiefly for grazing, all kinds of stock being exceedingly fond of it. It grows freely on sandy soils where other grasses will not thrive, and resists extreme drought and high temperatures. It is particularly a sun-loving grass, and will not thrive in the shade. It is useful for binding drifting sands and the loose soil of embankments or those subject to wash. It makes a pleasing lawn grass, and is extensively used for this purpose in the hotter portions of the United States, for it will thrive where the grasses ordinarily employed for lawns could not survive. The yield of hay under good conditions is from 3 to 4 tons to the acre, and as high as 10 tons to the acre have been produced under peculiarly favorable circumstances. While this grass will survive the winters of the latitude of Philadelphia, the leafage is very sensitive to cold and turns brown with the first frosts. This fact renders it objectionable as a lawn grass, except in regions where the winter season is very mild. In many portions of the Southern States there is probably no grass equal to Bermuda for summer pastures, and none which will better resist the trampling of stock. Bermuda does not mature seed except in the extreme southern portion of our country, but seed obtained from more southern latitudes is offered for sale by some of our leading seed dealers. The most direct and certain method of propagation is by transplanting, which may be effected by cutting up Bermuda turf into small pieces, scattering these along shallow furrows and covering them lightly. When once established, Bermuda grass is very persistent and difficult to eradicate, and it should not be introduced upon land which is likely to be used for other crops. New York catalogues quote the seed at $1 to $1.25 per pound, retail. In the vicinity of

Washington, D. C., Bermuda-grass is known as wire grass, and in Australia it is called Couch-grass.

No. 80. Cynosurus cristatus Linn. Crested Dog's-tail. (Fig. 33).

A slightly tufted perennial grass, 1 to 2 feet high, with fine and chiefly radical leaves. It is a native of Europe and is adapted to cultivation in moist, temperate regions, and has been sparingly introduced into this country. On moist, rich land it is fairly productive, but is rarely sown alone, excepting for seed or the formation of lawns, for which latter purpose it is well adapted, as it forms an even and compact sward when thickly sown. It is said to thrive well in the shade, a fact which gives it importance to those having shaded lawns. It forms a good bottom grass, has a highly nutritive value, and is recommended for all mixtures used for permanent pastures, especially in hilly regions. The mature stems of this grass are among the most valuable of those used in the manufacture of Leghorn hats. Number of seeds in a pound of pure seed is about 1,127,000. Price of seed in New York, 40 to 60 cents per pound, or $7 to $12 per bushel of 21 pounds.

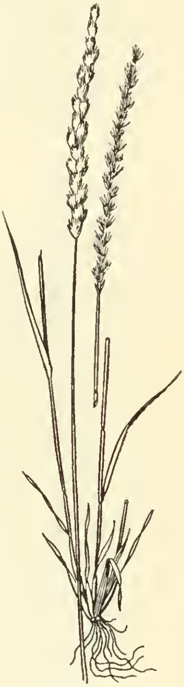


Fig. 33.—Crested Dog's-tail (*Cynosurus cristatus.*)

No. 81. Dactylis glomerata Linn. Orchard-grass. (Fig. 34.)

This is one of the best known and most popular of our cultivated grasses. It will grow well on any soil containing a reasonable amount of fertility, excepting that which is very wet. It is a hardy grass and may be grown successfully anywhere in the United States, except in the extreme South and in the arid regions of the West. It yields an abundant crop of excellent hay, and may be sown alone for this purpose, but owing to its habit of forming tufts or tussocks, the land should be seeded heavily or the seeds should be mixed with other kinds, to act as fillers or bottom grasses. It is a good pasture grass, especially for open woodlands, and affords excellent grazing earlier than almost any other species. The aftermath is unequaled in amount by any of the grasses ordinarily cultivated for hay. When sown with other grasses, the tendency of Orchard-grass to form tussocks is much diminished and the sward greatly improved. Heavy rolling is also recommended for checking or preventing the tufted growth which this grass naturally assumes. By this operation the tufts are pressed down to the level of the other grasses and the turf becomes more uniform. In old, rich meadows of Orchard-grass it is advisable to harrow in the spring and afterwards use the roller. Its best record of yield, made by Sinclair, was 27,905 pounds green, 11,859 pounds of hay, and 11,910 pounds of green aftermath per acre. Sow 3 to 4 bushels to the acre. The average number of grains in one pound of pure seed is 579,500. Price of seed, as given in New York catalogues, $3 per bushel of 14 pounds. In England Orchard-grass is known as Cock's-foot.

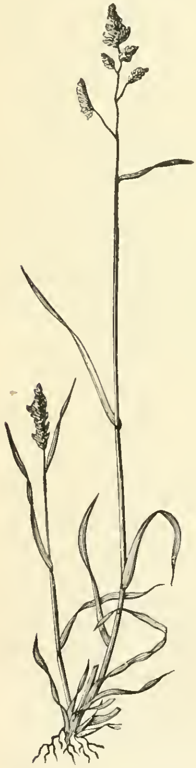


Fig 34.—Orchard-grass (*Dactylis glomerata*).

No. 82. Dactyloctenium aegyptium (Linn.) Willd. Crowfoot-grass. (Fig. 35.)

This grass, which is a weed throughout all the warmer countries of the world, has become quite common in some of the Southern States. It closely resembles the more common Goose-grass or Duck's-grass (*Eleusine indica*), from which it differs chiefly in having the terminal spikes shorter and each tipped with a sharp prolongation of the axis. It is usually found in cultivated fields, and often in such abundance as to displace the less vigorous native sorts, and is sometimes cut for hay. In parts of Africa, where this grass is common, a decoction is prepared from the seeds, which is used for inflammation of the kidneys. In Australia it is valued for pasture. In India the grain is sometimes used for food by the natives in times of scarcity. The Mohave Indians of California also use the grain for food, grinding it and making the flour into cakes or mush. (C. R. Orcutt.)

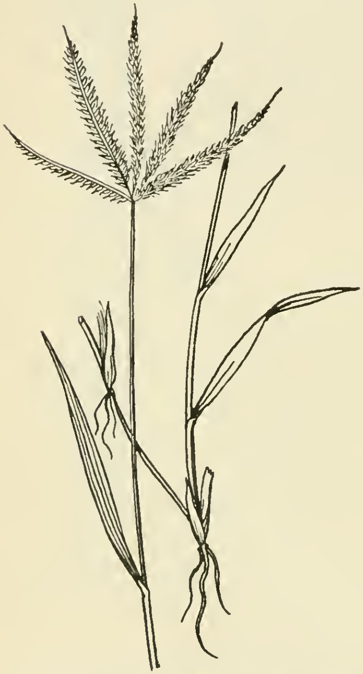


Fig. 35.—Crowfoot-grass (*Dactyloctenium ægyptium*).

No. 83. Danthonia compressa Austin. Tennessee Oat-grass.

A slender, erect, tufted perennial, usually growing to the height of about 2 feet, with long and narrow root-leaves, and few-flowered spreading panicles. It is a common grass in the hilly regions of New England and the Middle States, and extends southward into North Carolina and Tennessee along the mountains, where it forms the bulk of the forage of the so-called "balds" or parks which are common to mountains in the South. It is highly nutritious, as determined by chemical analysis, as well as by its effect upon the stock grazing upon it. It stands well the trampling and grazing of both horses and cattle, but sheep are too close feeders, and where these range it soon disappears.

No. 84. Deschampsia cæspitosa (L.) Beauv. Tufted Hair-grass.

A native perennial, ranging from New England to Pennsylvania, and westward to the Pacific Coast. It yields an inferior, coarse, harsh forage, and is not eaten by stock except when young. It has a record of producing 10,209 pounds green and 3,318 pounds dry hay per acre. Johnson, in his work on British grasses, says of the tendency of Tufted Hair-grass to form tussocks: "In the economy of nature these tufts, so unsightly and disfiguring to the landscape, are valuable by contributing to elevate and solidify low lands liable to be overflowed by rivers, and where they occur on hill and mountain slopes, by binding the spongy soil and preventing the slips which would leave them bare." This grass is most abundant in the Rocky Mountain region, where it doubtless serves to a considerable extent the purpose here mentioned. In England it is sometimes used by the farmers to make door mats. In Germany it furnishes the "Lyme-grass" used in upholstery. Price of the seed in New York, $22 per 100 pounds.

No. 85. Deschampsia flexuosa (L.) Trin. Wood-Hair grass. (Fig. 36.)

A slender perennial grass, 1 to 2 feet high, with numerous very fine root-leaves and a delicate capillary panicle. It grows in tufts like *Deschampsia cæspitosa*, and is more common in the Eastern States than that species, but is even less valuable for meadows. It is, however, of some value for woodland pastures, as it will grow very well in the shade. It extends southward along the mountains into North Carolina and Tennessee. Its range westward is limited. It has a record of producing 12,209 pounds of rowen and 3,318 of dry hay per acre. The price of seed quoted in New York catalogues is $15 per 100 pounds.

No. 86. Distichlis spicata (L.) Greene. Salt-grass. (Fig. 37.)

An upright, wiry grass, 10 to 20 inches high, with strong, extensively creeping rootstocks. Common along the coast on both sides of the continent, and abundant in the alkaline regions of the interior, where it is often found covering considerable areas to the exclusion of other grasses. It thrives even in ground heavily crusted with alkali and other salts sufficient to destroy almost any other kind of vegetable growth. Prospectors and miners consider its presence a sure sign of water near the surface, and when crossing the desert select spots where it grows to dig for water (Orcutt). In farming lands it is deemed a nuisance, for its tough, matted roots make a sod almost impossible to break up with a plow. Although sometimes eaten by stock in the absence of better sorts, it has little agricultural value. It is a good grass for binding loose sands or soils subject to wash.

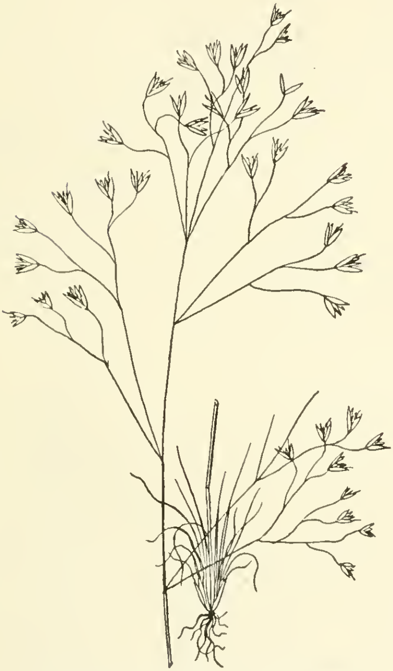


FIG. 36.—Wood Hair-grass (*Deschampsia flexuosa*).

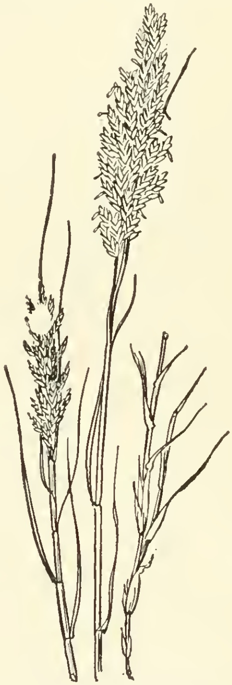


FIG. 37.—Salt-grass (*Distichlis spicata*).

No. 87. Eatonia obtusata (Michx.) Gray. Early Bunch-grass.

A tufted perennial, 1 to 2 feet high, with flat leaves and rather densely flowered nodding panicles. This is a native species, growing usually in moist soil, and ranging from New York to California and southward. A tender grass, readily eaten by stock, which, when abundant, supplies considerable native forage of good quality.

No. 88. Eleusine coracana (L.) Gærtn. African Millet.

An erect annual grass, 2 to 4 feet high, closely related to and much resembling our common crowfoot (*Eleusine indica*), but of rather stouter habit and with larger spikes and seeds. It is cultivated in India, southern China, Japan, and in many parts of Africa for the grain, which is used as food. It forms the principal food of many African tribes. In spite of the bitter taste of the flour, a kind of bread or unleavened cake is made of it. Beer is brewed from the grain in Abyssinia. Said to yield good crops, even on very poor soil, and may be cultivated in the same way and for the same purposes as millet. The seeds are marked with very fine, comb-like lines.

No. 89. Eleusine indica (Linn.) Gærtn. Goose-grass. (Fig. 38.)

A coarse, tufted annual, with erect or spreading stems, 6 inches to 2 feet high; spikelets arranged in a number of spikes which are clustered at the top of the stem. This grass is distributed throughout the warmer countries of the globe, and is particularly abundant in the Southern States, growing in cultivated grounds about dwellings, etc. It has somewhat wiry, flattened stems, many springing from a single root, and rather thick leaves. Some authors have spoken of it as being nutritious and good for grazing or soiling and for hay, but it is more generally regarded as a weed, and often a troublesome one in dooryards or lawns.

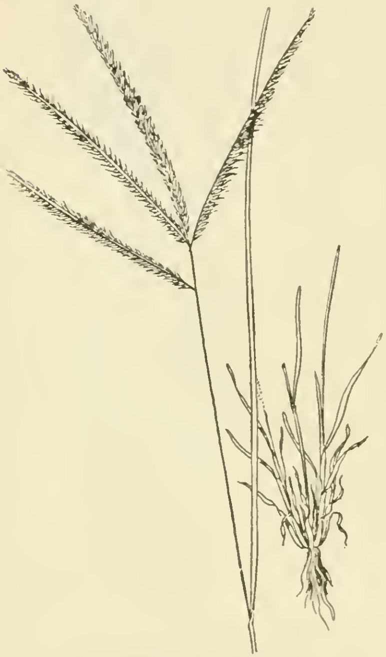


FIG. 38. Goose-grass (*Eleusine indica*).

No. 90. Elymus arenarius Linn. Sea-Lyme-grass. (Fig. 39.)

A stout, coarse grass, 2 to 8 feet high, with strong, creeping rootstocks, smooth stems, long, rigid leaves, and dense terminal spikes 6 to 12 inches long. The spikelets are about an inch long and three- to four-flowered. This grass is common along the seacoast of northern Europe, our north Atlantic coast, and on our Western shores from Santa Cruz, Cal., northward to within the Arctic zone. It is one of the best grasses known for binding the drifting sands of the coast, and in northern Europe has been cultivated along with Beach-grass for this purpose. These two grasses when combined seem admirably adapted for the purpose of forming a barrier to the encroachment of the sea; the sand that Beach-grass arrests and collects about itself the Lyme-grass secures and holds fast. The seeds are used for food by the Digger Indians of the Northwest, and as the grass springs up around their deserted lodges it is called by the settlers "*Rancheria*" grass. This Lyme-grass is usually regarded as possessing little or no forage value, but in very moist climates or under certain favorable conditions it may yield a valuable fodder, for when young the grass is tender and nutritious.

No. 91. Elymus canadensis Linn. Wild Rye.

A rather stout, smooth perennial, 3 to 5 feet high, with broad, flat leaves, 6 to 12 inches long. The bearded spikelets are arranged in a terminal spike or "head," which has some resemblance to a head of rye. Common in low thickets and along streams in rich, open woods throughout the country. In the Northwest it is regarded as of some agricultural value; its cultivation is evidently worthy of trial, for if it could be successfully grown its yield of hay would be large, and, judging from appearances, the hay would be of good quality.

No. 92. Elymus condensatus Presl. Giant Rye-grass.

The largest of the native Rye-grasses, growing to the height of 5 to 10 feet. Common in the Rocky Mountain regions and on the Pacific slope, usually growing along rivers or streams the banks of which are protected and held together by the strong, spreading rootstocks of the grass. This grass is useful for holding the sand on railway banks, etc. When young this grass makes excellent hay, and when allowed to stand it affords a considerable amount of fodder for stock on the winter ranges. The seeds are used for food by the Indians.

No. 93. Elymus macounii Vasey. Macoun's Rye-grass.

A perennial grass, found quite abundantly in moist meadows, in the gravelly foothills of the northern Rocky Mountains. The culms are leafy, and this grass contributes quite largely to the native hay cut by the ranchers of the Northwest. It is apparently a very valuable species.

No. 94. Elymus mollis Trin. Soft Sea Lyme-grass.

A grass which closely resembles and has the same habit of growth as *Elymus arenarius*. It is distinguished by having the stem soft-downy just below the head or spike and in having five to seven flowered spikelets, the outer glumes of which are broader and five- to seven-nerved. This grass occurs along the shores of the Great Lakes and northward on both the Atlantic and Pacific coasts.

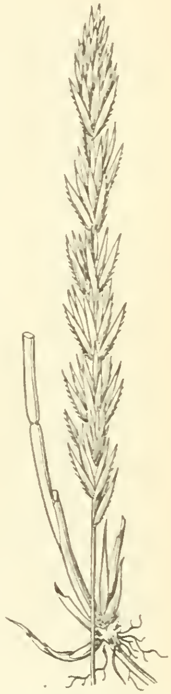


Fig. 39.—Sea Lyme-grass (*Elymus arenarius*).

No. 95. Elymus triticoides Nutt. Wild Wheat.

By some this has been regarded as a small, reduced form of *Elymus condensatus*, mentioned above. It grows to the height of 2 to 3 or 4 feet and is native of the Rocky Mountain region and Pacific Slope, extending eastward nearly to the Mississippi. While it is a grass of good appearance and possibly of some agricultural value, no attempts have been made to cultivate it.

No. 96. Elymus virginicus Linn. Terrell-grass. (Fig. 40.)

The most common of our native species of Lyme-grass, growing along streams, the borders of woods and thickets, more rarely in the open ground. It is an erect, smooth grass, 2 to 3 feet high, with rigid terminal spikes, which are often partly included within the upper leaf-sheath. This grass has the appearance of possessing some agricultural value: it forms an inferior turf, and by the time it blooms all the lower leaves are usually dead. When young it doubtless possesses some value as a native pasture grass. In Kansas, South Dakota, and Nebraska it is regarded a valuable grass for woodland pastures.

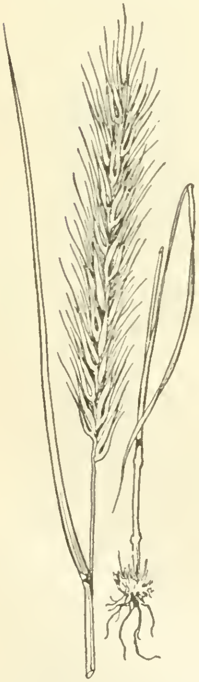


Fig. 40. — Terrell-grass (*Elymus virginicus*).

No. 97. Epicampes rigens Benth. Deer-grass. (Fig. 41.)

A stout, erect grass, 3 to 4 feet high, with rigid, wiry stems, and a very long, narrow, densely flowered, spike-like panicle. This grass is not uncommon in Arizona, southern California, and New Mexico, growing in sandy soil. It is regarded as one of the best native dry-land grasses, and is closely grazed wherever stock can get at it. The roots of *Epicampes macroura* — Mexican Broom-root or Mexican Whisk—are used in making brushes and are exported from Vera Cruz to Europe for this purpose.

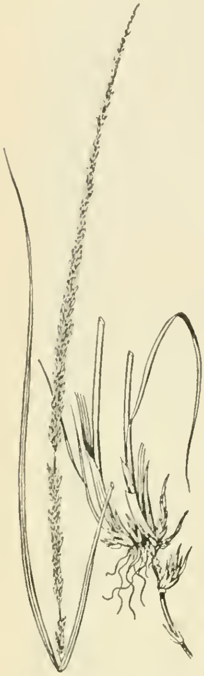


Fig. 41.—Deer-grass (*Epicampes rigens*).

No. 98. Eragrostis abyssinica Link. Teff.

A branching, leafy annual, 2 to 4 feet high, with widely spreading capillary panicles of many spikelets. This grass grows readily from seed, which is produced abundantly, and it may be of some value for hay in parts of the South or Southwest. In northeastern Africa, where the grass is apparently native, the grain is extensively used for food, being made into bread, which possesses a slight but agreeable acid taste. There are two varieties cultivated, a white and a red variety, the former being much superior to the latter and used only by the higher classes. It is sometimes grown in gardens for the elegant panicles, which are used in bouquets. *Eragrostis neomexicana* Vasey, with the general habit of growth of Teff, occurs in New Mexico, springing up after rains, particularly in the region about Deming, where it is called "Crab-grass." It is an annual, growing to the height of 2 to 4 feet, with widely spreading, many flowered panicles, and is largely cut for hay.

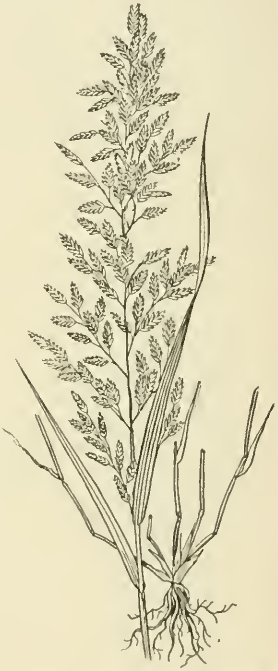


Fig. 42.—Stink-grass (*Eragrostis major*).

No. 99. Eragrostis major Host. Stink-grass. (Fig. 42.)

A rather showy, much-branched annual, with erect or ascending stems, 6 inches to 2 or 3 feet high. This species, which is a native of Europe, has become widely distributed in this country, growing chiefly in cultivated or waste grounds, especially in light soils. When fresh it emits a strong, unpleasant odor.

No. 100. Eragrostis obtusiflora (Fourn.) Scribn. Mexican Salt-grass.

A rigid perennial, 12 to 18 inches high, with strong and extensively scaly rootstocks, stiff and sharp-pointed leaves, and more or less spreading panicles. Abundant in the highly alkaline soils of Sulphur Springs Valley, Arizona, where the large rootstocks serve to bind the shifting sands. In the absence of other grasses it is eaten by stock.

No. 101. Eragrostis pilosa (Linn.) Beauv. Slender Meadow-grass.

A slender branching annual, 6 to 18 inches high, with narrow, flat leaves and capillary, open panicles. This grass is widely distributed throughout the subtropical and warmer temperate regions of both hemispheres. In this country it has received no attention or is regarded as little more than a weed, but in Australia and India it is spoken of as being an excellent fodder grass, and the seeds are eaten by the natives of Ajmere, India.

No. 102. Eragrostis purshii Schrad. Southern Spear-grass.

A native annual, similar in appearance to *Eragrostis pilosa,* and growing in similar situations. It is common from the Middle States southward, and extends southwestward into Texas and Arizona, where it exists in a great variety of forms. It grows to the height of 1 to 2 feet. It is nowhere considered of any agricultural importance.

No. 103. Erianthus ravennæ Beauv. Plume-grass.

A stout grass growing to the height of 8 or 10 feet, with large and plume-like panicles 10 to 20 inches long, resembling in some degree Pampas-grass. Cultivated for lawn decoration, as is also the variety with variegated leaves. A native of the Mediterranean region.

No. 104. Erianthus saccharoides Michx. Plume-grass.

A tall stout grass of striking appearance, 4 to 6 feet high, with a reddish or silvery-white showy panicle from 5 to 10 inches long. This grass ranges from New Jersey to Illinois and southward to the Gulf, growing in very wet places and open swamps. Of no agricultural value, but deserves notice as an ornamental grass for lawns and gardens.

No. 105. Eriochloa aristata Vasey. Mexican Everlasting-grass.

A branching leafy annual, 2 to 3 feet high; native of Mexico. Seed of this grass was obtained by the Department in 1888. It was cultivated in the grass garden located at Starkville, Miss., by Prof. S. M. Tracy, who says that it is a much more promising grass than *E. annulata,* more hardy, less injured by drought, and produces a heavier growth. It will make two good crops of hay annually in the South, the best crop being from the second growth, which is ready to cut in October. The grass produces an abundance of seed and reseeds itself, making its production comparatively inexpensive.

No. 106. Eriochloa punctata (Linn.) Hamilt. Everlasting-grass.

A quick-growing, smooth, succulent perennial, 2 to 3 feet high, with flat leaves and narrow panicles 2 to 4 inches long. Widely distributed within the tropical and subtropical regions of both hemispheres. In Australia it is regarded as an excellent pasture grass, lasting all the year round and well liked by stock. The seed, which is produced abundantly, is easily gathered. This grass deserves the attention of Southern dairymen. In Arizona it grows throughout the valleys in irrigated soil, or in the rich moist places of the plains, yielding abundant herbage eagerly sought by all kinds of stock.

No. 107. Eriocoma cuspidata Nutt. Indian Millet. (Fig. 43.)

A grass of rather striking appearance, 1 to 2 feet high, widely distributed throughout the Rocky Mountain region from British America southward to Texas and New Mexico, eastward to the Missouri, and westward to the Sierras of California. It grows in dry sandy soils, forming bunches of greater or less size, and from this habit of growth it has been called, along with a number of other grasses, "Bunch-grass." It thrives in soil too dry and sandy for the growth of most other grasses, and is much esteemed for grazing in the regions where it abounds. In New Mexico this grass is by some deemed superior to grama, on account of its large and nutritious seeds or grains, which are used by the Indians to some extent for food.

No. 108. Euchlæna mexicana Schrad. Teosinte. (Fig. 44.)

A stout, leafy, annual grass, 8 to 10 or 12 feet high, resembling Indian corn, to which it is botanically closely related. The variety *E. luxurians,* of the seed catalogues, which has been cultivated in various parts of the South and West, has a habit of tillering, or sending up many—20 to 50—stalks from the same root (Plate III, fig. 1). From this habit the bulk of fodder produced to the acre is very large, probably unequaled by any other grass. It is liked by all kinds of stock, and has especial value as a green fodder when other forage is dried up. It may be cut several times during the season, but nearly as good results will be obtained from a single cutting, made before there is any frost. The stalks are tender, and there is no waste in the fodder when dry or green. One pound of seed to the acre, planted in drills 3 feet apart and thinned to a foot apart in the drill, is recommended. It is a native of the warmer portions of Mexico and Central America. The seed rarely matures north of southern Florida.

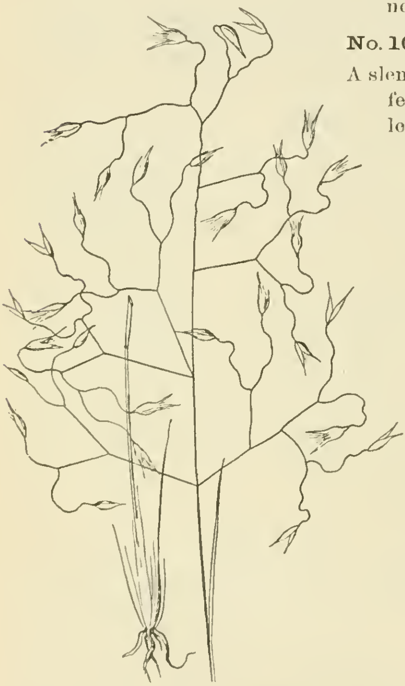


FIG. 43.—Indian Millet (*Eriocoma cuspidata*).

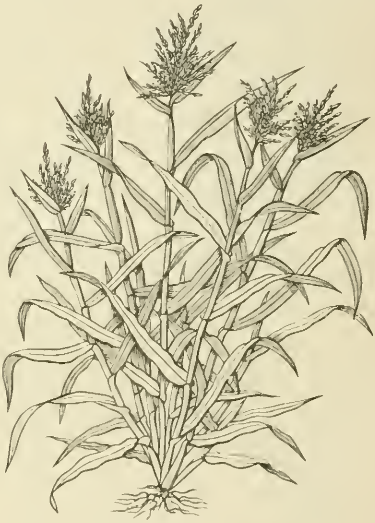


FIG. 44.—Teosinte (*Euchlæna mexicana*).

No. 109. Festuca duriuscula Lam. Hard Fescue.

A slender, densely tufted, perennial grass, 1 to 2 feet high, with numerous very fine radical leaves and open panicles. This is one of the forms of Sheep's Fescue, and is of little value except in pastures. Its particular merit lies in its ability to thrive on dry sandy soils unfit for the growth of better grasses, and it well resists long periods of summer drought. It is well adapted to the cooler and mountainous regions of our country, being a native of the cooler temperate regions of both hemispheres. On well-manured, clayey land this Fescue has produced upon a single acre 18,376 pounds of green hay at time of flowering, and 8,269 pounds of hay besides 10,029 pounds of aftermath. It possesses some value as a lawn grass, but if used for this purpose it should be sown thickly and unmixed with other sorts. Sow 2½ to 3 bushels to the acre. Price of seed in New York market, $16 to $18 per 100 pounds.

No. 110. Festuca elatior Linn. Tall, or Meadow Fescue.

This grass has been widely cultivated in this country, having been introduced from Europe, and has become thoroughly naturalized. It is an exceedingly valuable

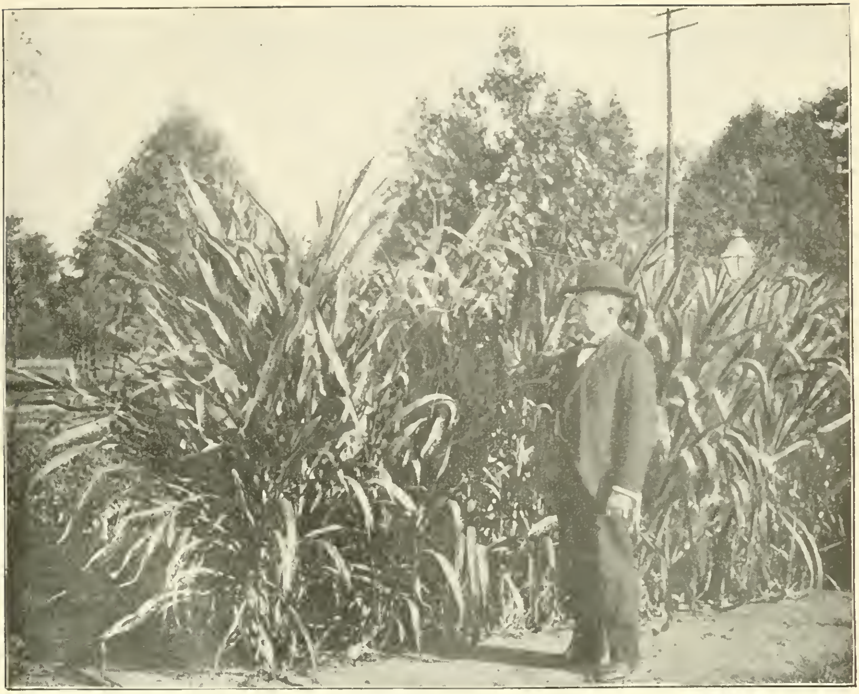


FIG. 1.—YOUNG PLANTS OF TEOSINTE IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

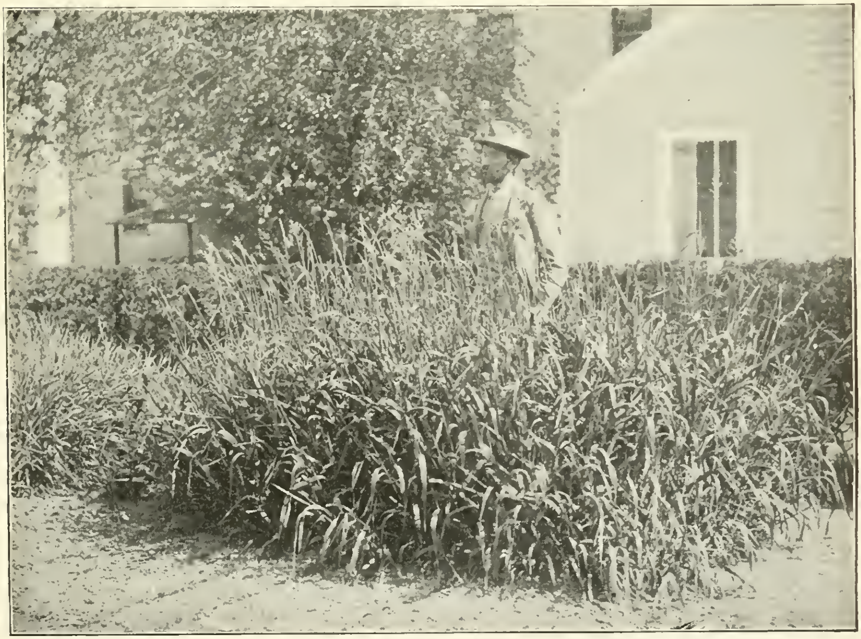


FIG. 2.—REED CANARY GRASS IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

grass either for mowing or pasture. It is productive on soils which are not too dry, and, being of long duration, is especially valuable for permanent pastures. It thrives best on moist soils rich in humus, whether marls or clays. The variety *pratensis*, or Meadow Fescue, is a common form, rather smaller than the species, with a narrower and fewer-flowered panicle. Variety *arundinacea*, or Reed Fescue (fig. 45), is a very vigorous, tall form, 3 to 4 feet high, exceedingly hardy, and yields a very large amount of hay of excellent quality, succeeding best on lands that are comparatively moist. The seed of Meadow Fescue is quoted in some of the New York catalogues at $3.50 per bushel or $22 per 100 pounds. A bushel weighs about 14 pounds.

No. 111. Festuca heterophylla Lam. Various-leafed Fescue.

A rather slender European grass, 2 to 4 feet high, with very narrow (setaceous) root-leaves, and narrow but flat culm leaves. It is a perennial, closely related to Creeping Fescue, of which it has been made a variety by some authors. The panicle is comparatively large, open and nodding at the apex. It is a species preferring a rather mild climate, and grows naturally in open woodlands or along their borders. It makes its best growth on low-lying lands which are not too dry, but upon good soil it withstands protracted periods of drought very well. Owing to the great production of fine root leaves, this species makes a good bottom grass, and as these leaves are quite soft the grass is well adapted for lawns, and is particularly recommended for those which are too much shaded for the successful growth of other lawn grasses. It is an excellent grass, also, for woodland parks where the soil is not sandy. European authorities have classed it with the best forage plants. It is little known in this country, but the seed is offered for sale by our leading seedsmen, the retail price being from $2.75 to $3 per bushel of about 14 pounds.

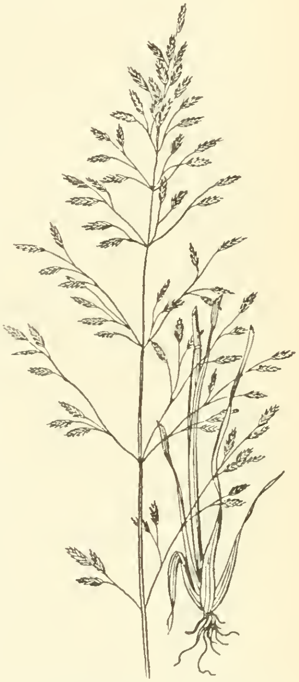


Fig. 45.—Reed Fescue (*Festuca elatior arundinacea*).

No. 112. Festuca kingii (S. Wats.) Scribn. King's Fescue.

A tall diœcious bunch grass, common in the foothills and canyons of Colorado and Montana. It is a very robust species, and supplies a large amount of good though coarse winter forage. Growing naturally at an elevation of 7,000 to 8,000 feet, it might prove valuable in cultivation in similar localities.

No. 113. Festuca ovina Linn. Sheep's Fescue.

Sheep's Fescue exists in many varieties in the Northwestern States, especially in the Rocky Mountain region. Some of these varieties attain the height of 2 or 3 feet, but for the most part they are rarely more than a foot high, producing a large amount of fine herbage, which is valuable for grazing, especially for sheep. Some of the native varieties are well worthy the attention of the agriculturist. All the forms of *Festuca ovina* are "bunch-grasses," and are devoid of the creeping roots, the presence of which distinguishes the Red Fescue (*Festuca rubra*) from this species. Sheep's Fescue is well adapted for cultivation on light, dry soils, especially those which are shallow and silicious. Although a native of this country, our seed supply comes mostly, if not entirely, from Europe, where the grass is also native. Sow 2½ to 3 bushels per acre. The weight of a bushel of seed is about 14 pounds. Price per bushel, $2.25 to $2.75 in New York.

No. 114. Festuca rubra Linn. Red Fescue.

This grass grows along the Atlantic coast of the New England and Middle States, and in the Northern States, extending westward to the Pacific. Like *Festuca ovina,* it presents many forms, but in some respects is superior to that species, as by its creeping rhizomes it will form a compact and durable turf. On account of this habit of growth, it is a useful grass for binding moving sands along the seacoast, or covering gravelly banks and dry slopes. In Germany, Red Fescue is regarded as one of the most valuable grasses for dry, sandy meadows. Owing to the great production of fine root leaves, this species makes a good bottom grass, and as these leaves are quite soft the grass is well adapted for lawns, and is particularly recommended for those which are too much shaded for the successful growth of other lawn grasses. It is an excellent grass also for woodland parks where the soil is not sandy. European authorities have classed it with the best forage plants. It is little known in this country, but the seed is offered for sale by our leading seedsmen, the retail price being from $2.50 to $3 per bushel of about 14 pounds. A variety, *F. rubra glaucescens* Hack. (fig. 46), is the best pasture grass in the mountain meadows of North Carolina and East Tennessee.

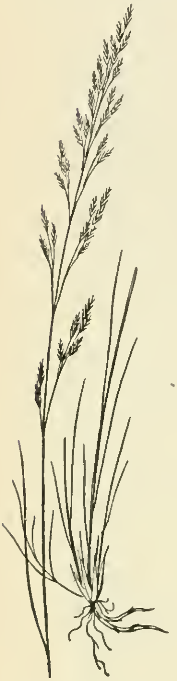


Fig. 46.—Tennessee Fescue (*Festuca rubra glaucescens*).

No. 115. Festuca scabrella Torr. Great Bunch-grass. (Fig. 47.)

A strong perennial, growing in large tufts or bunches 1 to 3 or 4 feet high. A native of the Rocky Mountain regions, extending from Colorado northward and westward to California and Oregon. It often occupies extensive mountain parks, to the exclusion of other grasses, where it affords excellent grazing. It may be cut for hay, of which it furnishes a large amount, excellent in quality, especially for horses. It is one of the best grasses for winter stock ranges. In the Northwest, particularly in the Rocky Mountain region, there are many native species of the genus *Festuca* which are well deserving the attention of stockmen and farmers.

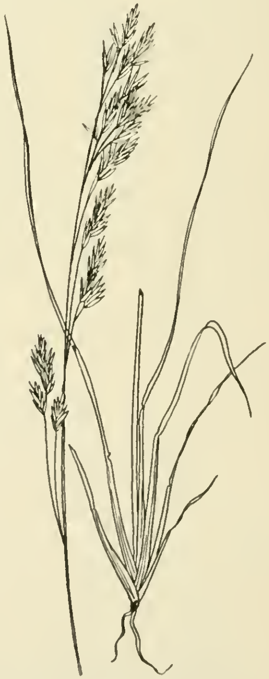


Fig. 47.—Great Bunch-grass (*Festuca scabrella*).

No. 116. Festuca tenuifolia Sibth. Slender Fescue.

A low and fine-leafed grass, in habit of growth resembling *Festuca ovina,* of which it is regarded as only a variety by most authors. It has no special agricultural value, but will grow in dry and comparatively sterile soil. Its fine, hair-like leaves and densely cespitose habit of growth render it a good lawn grass when properly treated, especially for shady places, and it is also a good plant for edgings.

No. 117. Fourniera mexicana Scribn. Mexican Lawn-grass.

A low, extensively creeping grass that grows in the mountain valleys of western Mexico. Stock eat it with avidity. An excellent lawn and pasture grass for subtropical regions.

No. 118. Gynerium argenteum Nees. Pampas-grass.

A stout perennial, 8 to 12 feet high, with mostly radical, narrow leaves 3 to 6 feet long, and showy, silvery white or rose-red panicles 15 to 30 inches long. A much-prized ornamental for lawn decoration. The handsome panicles are used for dry bouquets. Growing Pampas plumes is an important industry in some parts of California. These plumes or panicles are cut when exposed only a few inches from the leaf sheath, then dried, and done up into bundles for shipment. Pampas-grass is a native of southern Brazil and Argentina, and there the long leaves are used for paper making, and a decoction of the rhizome is used as a diuretic. *G. roseum* is a horticultural variety, with pale, rose-colored plumes. *G. variegatum* is a form with variegated leaves.

No. 119. Hilaria cenchroides HBK. Curly Mesquit. (Fig. 48.)

A delicate perennial with slender, creeping stems, the upright, leafy shoots a few inches to nearly a foot high. This is one of the most valuable of the grasses of the dry plains and mesas of the Southwest. It forms a dense, green sward, and in habit of growth closely resembles the true Buffalo-grass. It has the habit of creeping over the ground and rooting at the joints of the stems, from which spring leafy branches that in turn reach out for other places in which to take root. It makes a thick mat of leafy turf during the summer, matures on its roots, and in the fall and winter, when not rotted by late rains, affords excellent pasturage for all classes of stock. No grass stands the long dry spells to which the Southwest is periodically subject better than the Curly Mesquit. At such times it dries up and appears dead, but in a few hours after a warm rain it becomes green to the end of the smallest branches. It is best propagated by transplanting the runners. Seed is produced in abundance, but is both difficult to harvest and of rather uncertain vitality.

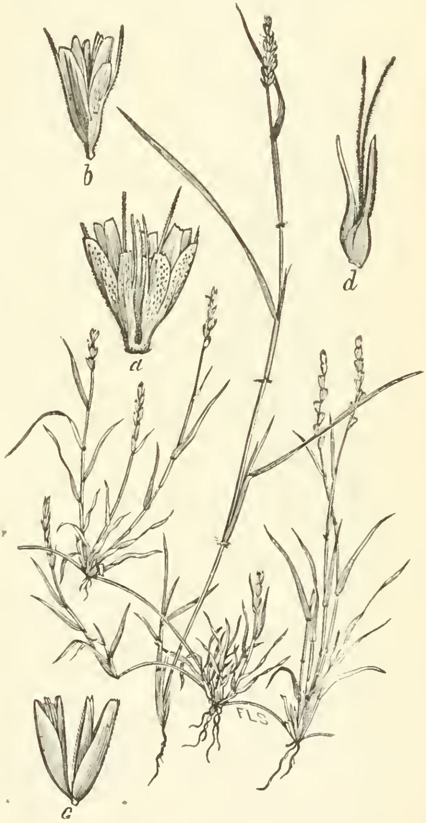


Fig. 48.—Curly Mesquit (*Hilaria cenchroides*); *a*, group of spikelets; *b*, spikelet; *c*, *d*, florets.

No. 120. Hilaria mutica Benth. Black Bunch-grass.

This is a rather coarse perennial, with creeping rootstocks, and stems 12 to 18 inches high. It is common on the dry mesas of New Mexico and Arizona, extending eastward into Texas and Indian Territory. Where abundant it is regarded as one of the most valuable native grasses and furnishes excellent pasturage at all times when not covered with snow, and is frequently cut for hay. It forms dense patches of greater or less extent on hillsides, mesas, and plains. It is also called "Black grama," and is largely gathered for hay, being uprooted with a hoe. (Pringle.)

No. 121. **Hilaria rigida** (Thurb.) Scribn. Galleta. (Fig. 49.)

In the driest regions of southern California and Arizona, growing in the deserts where other grasses are rarely seen. It has coarse, much-branched, and woody stems, 2 feet high or more, growing in great clumps, resembling in its habit some of the dwarf bamboos. The stems and leaf sheaths are clothed with a dense, white-matted pubescence, which gives to the grass a peculiarly striking appearance. In the regions where it grows it is regarded as valuable forage for pack animals and mules, there being little other vegetation which they can eat. Without this grass miners and prospectors would find great difficulty in traversing the arid mountain and desert regions of the Southwest, since scarcely any other forage plants occur in the districts occupied by it (Orcutt). The Hilarias, of which we have four species, are grasses peculiarly adapted for growth in the drier lands of the Southwest, and although they are, with the exception of *Hilaria cenchroides*, wiry and tough, the forage they afford is very acceptable in the absence of more succulent plants.

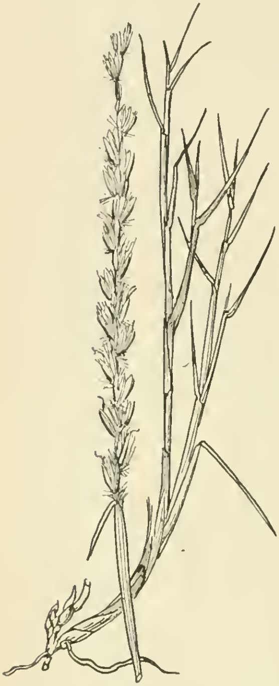


Fig. 49.—Galleta (*Hilaria rigida*).

No. 122. **Holcus lanatus** Linn. Velvet-grass. (Fig. 50.)

A perennial, 1 to 2 feet high, with a creeping rootstock, and stems and leaves clothed all over with a soft, whitish pubescence. This grass has been introduced into this country from Europe, and has become naturalized in many places. It possesses little nutritive value, and is not well liked by stock, particularly horses. It possesses some value, however, on peaty or sandy soils where the better grasses will not grow. Its cultivation, however, is not recommended. It is entirely unsuited for lawns.

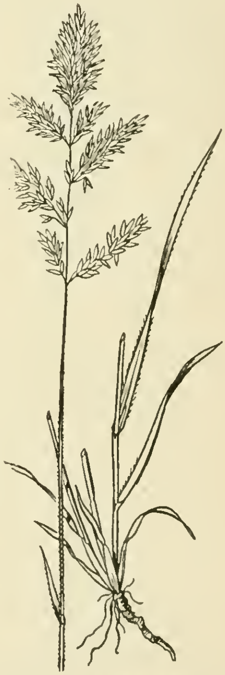


Fig. 50.—Velvet-grass (*Holcus lanatus*).

No. 123. **Holcus mollis** Linn. Creeping Soft-grass.

Closely allied to Velvet-grass, and said to be similarly well adapted to light, sandy forest lands. It is occasionally found in the Eastern States, the seed having been introduced with that of other grasses from Europe, as both *Holcus mollis* and *Holcus lanatus* are often used to adulterate the seeds of more expensive grasses, especially the so-called prepared mixtures of seedsmen. In Germany this grass is used on railway embankments, where on the poor, thin soil its strong, creeping roots form a turf which holds the earth together, thus preventing it from being washed or blown away.

No. 124. Hordeum jubatum Linn. Squirrel-tail-grass. (Fig. 51.)

A rather slender annual or biennial, usually about a foot high, growing along the sandy seashore, borders of the Great Lakes, and in the alkaline regions of the West. The long, slender awns of the glumes are widely spreading, and the head or spike is thus given the appearance of the "brush" of the fox, hence the common name, "foxtail." This grass is sometimes recommended for cultivation for ornament, and if the tops are cut off before the awns have expanded they may be used for dry bouquets; but the heads soon break up, and for this reason the grass is of little value even for ornament. It has no agricultural value, and, in fact, where it has spread in the West, as it often does along the irrigating ditches, it becomes a serious pest. Hay containing this squirrel-grass is considered nearly valueless. The sharp-pointed joints of the spike, each with several long and slender beards, stick fast in the nose and mouth of horses and cattle, often penetrating the flesh, and cases are reported where they have caused the death of these animals.

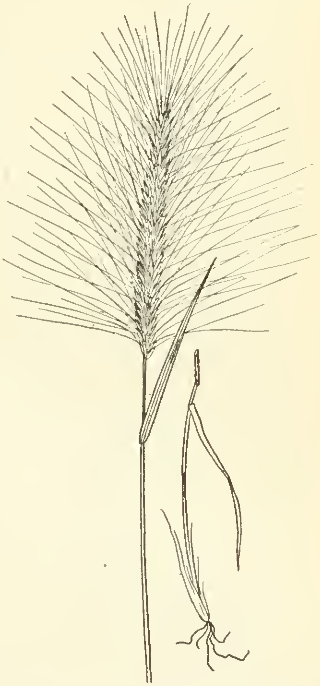


Fig. 51.—Squirrel-tail-grass (*Hordeum jubatum*).

No. 125. Hordeum murinum Linn. Wall Barley.

A coarse, tufted annual, 6 inches to 2 feet high, with dense and somewhat flattened, bearded spikes 2 to 4 inches long The beards or barbed awns are 1 to 1½ inches long and rather rigid. This grass is a native of Europe, and has been introduced along the Pacific Coast, particularly in California, where it has become a serious pest. At maturity the head or spike readily breaks up, and the groups of spikelets, which are sharp pointed at the base, adhere to almost any passing object; they work up the nostrils of cattle and into the fleece of sheep, and may do injury to the animals in much the same way as the native *Hordeum jubatum*.

No. 126. Hordeum sativum Jessen. Barley.

Cultivated barley presents many varieties, primarily divided into two-rowed, four-rowed, and six-rowed races. The varieties under these races are based upon the varied characters presented by the head, beards, or grain. All appear to have originated from *Hordeum spontaneum* Koch, which grows wild in the countries of southwestern Asia. Six-rowed barley has been in cultivation since prehistoric times in southern Europe; two-rowed barley is now largely cultivated in England and central Europe. The four-rowed barleys are of later origin than the others, and are most generally cultivated in northern Europe and in this country. The barley crop of the United States for 1895 was 87,072,744 bushels, of which amount six States produced over 73,000,000 bushels, California leading with 19,023,678 bushels. Barley is the most important cereal of the far north, some of the varieties being cultivated in Norway to latitude 70°. It is employed in making bread also in northern Asia and Japan. Barley soup is an article of diet in central Europe. From naked barley (*Hordeum decorticatum*) a mucilaginous tea is prepared, used in medicine. The grain is largely fed to horses, both in this country and in Europe, but the chief use is for brewing beer. "Brewers grains," a by-product, both wet and dry, are fed to cattle, chiefly in the vicinity of breweries.

No. 127. Hydrochloa carolinensis Beauv. Floating-grass.

A slender aquatic grass of the Gulf States, growing along muddy banks and in shallow streams. The stems are often 2 feet or more in length, and in shallow water their summits appear above the surface, while in water of greater depth the uppermost leaves are floating. The tender stems and leaves are eaten by stock, and may afford some food for waterfowl.

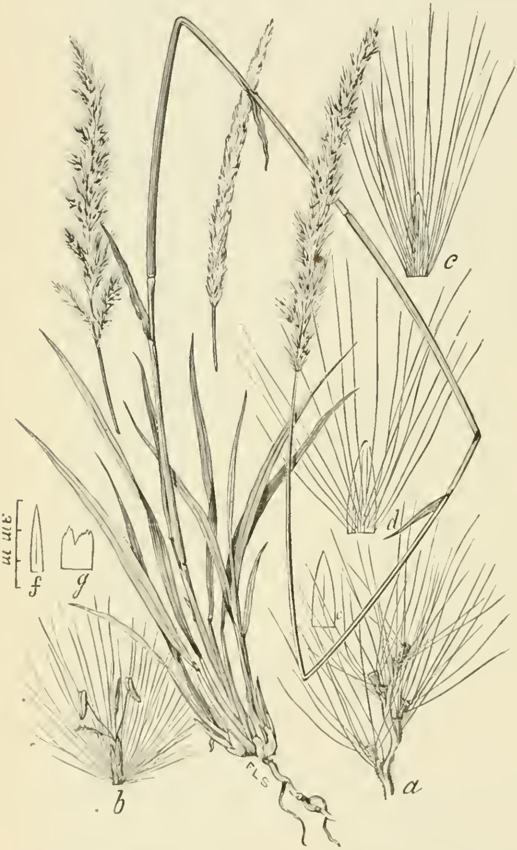


Fig. 52.—*Imperata hookeri*; *a* to *g*, details of spikelet.

No. 128. Imperata arundinacea Cyrill. Blady-grass.

A sand and soil binder common throughout the warmer temperate and tropical regions of both hemispheres. It is a stout, erect, leafy grass, 1 to 3 feet high, with silvery-white spike-like panicles. The rootstocks form a perfect network of strong fibers, and in warm countries the grass is recommended for binding river banks, the sides of dams, and the loose sands of the coast. This grass is easily propagated by root cuttings, and might be utilized along the Gulf Coast or along the Lower Mississippi in strengthening the levees. In the Malay Archipelago this *Imperata* is the principal grass of the Alang Alang fields, and is used by the natives for thatching roofs. Cattle eat it when young with apparent relish, and in Bengal it forms a very large portion of the pasturage. The Telingas make use of it in their marriage ceremonies. In western Texas and Arizona there is a native species, *Imperata hookeri* (fig. 52), very much like the one above described, in appearance and habit of growth. It grows naturally around the borders of alkaline springs.

No. 129. Isachne australis R. Br. Swamp Millet.

A slender grass, creeping at the base, the upright stems 1 to 2 feet high, with loose, open panicles of very small spikelets. It is a native of southern Asia and Australia, generally found growing along the sides of streams and on swampy ground. It is said to be liked by cattle, and Mr. Fred Turner recommends it for planting on the banks of rivers or dams to protect them from injury by heavy rains or floods. The underground stems and roots quickly form a perfect mat in the soil, and when once established they make a very firm turf. The grass may be propagated by seeds or pieces of the root.

No. 130. Kœleria cristata (Linn.) Pers. Prairie June-grass.

This is a common grass upon the open meadows and plains of the Central and Western States, and extends beyond the Rocky Mountains to the Pacific Coast. It is one of the "bunch-grasses" of the plains region, where it is generally associated with the more common Bunch-grass, *Poa buckleyana*. On the dry bench lands it is seldom over a foot high, but in irrigated ground grows to the height of 2 feet or more, and makes excellent hay. Its cultivation is not to be recommended where better grasses may be had. However, it possesses some value for furnishing early forage, and might be used in reseeding the native pastures.

No. 131. Lamarckia aurea Moench. Golden-top.

A low annual, 3 to 12 inches high, with flat leaves and elegant one-sided panicles 2 to 3 inches long. This very attractive and favorite ornamental grass is a native of southern Europe and southwestern Asia. It is frequently cultivated in gardens, and is a pleasing grass for edgings. It has escaped from cultivation in southern California, and has become apparently spontaneous there.

No. 132. Lolium italicum A. Br. Italian Rye-grass. (Fig. 53.)

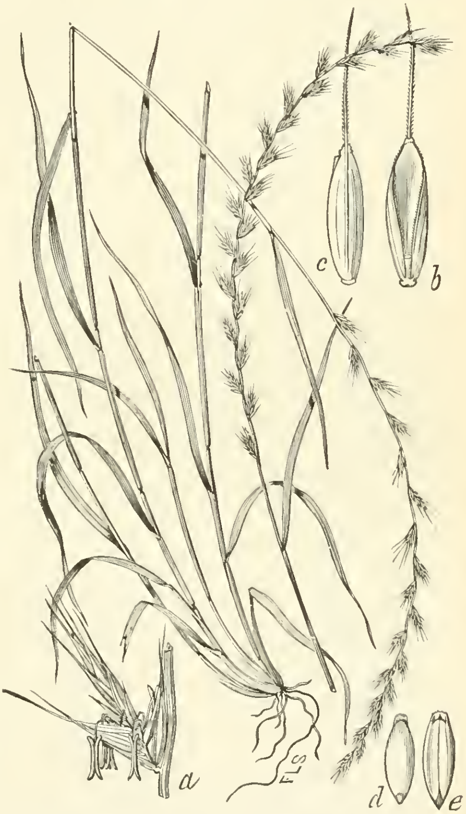


Fig. 53.—Italian Rye-grass (*Lolium italicum*): *a*, spikelet; *b*, *c*, florets; *d*, *e*, caryopsis.

A well-known and excellent grass for rich and rather moist lands, particularly for the Eastern States. It is a very rapid grower, forms a dense turf, and in Europe, whence the grass was introduced into this country, it is regarded as one of the best hay grasses. On stiff, heavy clays or on very dry soil it does not do well; but on good, calcareous loams or marls, or on moist, loamy sands, where the soil is in good condition, it is very productive, and no other grass repays manuring so well. It is not recommended for permanent pastures, as its duration is only two or three years, but it is a most excellent species for temporary meadows. Few grasses develop more rapidly than this, and where the soil is rich and its fertility maintained by applications of liquid manure, cuttings may be obtained within three or four weeks from seeding, and at intervals of a month or six weeks successive crops may be harvested. Owing to its succulent character and rapid growth, this makes one of the best grasses for soiling. Italian Rye-grass is at once distinguished from any of the forms of perennial Rye-grass by its awned or bearded spikelets. Adulterations of the seed of Italian Rye-grass are rare, owing to its relative cheapness. The average purity of commercial seed is 95 per cent, while the germinative power is 70 per cent. The germinative power diminishes rapidly with the age of the seed. One pound of seed contains on an average 285,000 grains, and the weight per bushel varies, according to the quality, from 16 to 24 pounds. Three bushels of seed of average quality are required for sowing an acre of land. The current price in the New York market is $10 per 100 pounds.

No. 133. Lolium perenne Linn. Perennial Rye-grass.

Perennial Rye-grass has been cultivated in England for more than 200 years, and is therefore one of the oldest if not the very first grass gathered and cultivated separately for agricultural purposes. It is indigenous to Europe, North Africa, and western Asia, and was many years ago introduced into this country from England. Here it has never been so highly esteemed as in England, where the soil and climate appear to be especially well adapted to its growth. Moist and rich loams or clays are the soils best suited to it, as with Italian Rye-grass, it responds promptly to the application of quick manures. For pastures on heavy soils in moist climates it is especially valuable, and under such conditions is largely used in mixtures for permanent pastures. It is a good hay grass where the conditions are favorable, but in this country will never be so highly esteemed as Timothy. There are several varieties of perennial Rye-grass recognized by agriculturists. Pacey's Perennial, a vigorous form, is one of these. The average purity of perennial Rye-grass seed is given at 95 per cent, and the germinative power at 75 per cent. Good commercial seed should grade higher than this. One pound of pure seed contains on an average 336,800 grains. Of course, where the seeds are larger and heavier, this number would be considerably less. The best seed weighs from 25 to 35 pounds per bushel, and 2 to 3 bushels of seed are required per acre. The current retail price of good seed is $8 per 100 pounds.

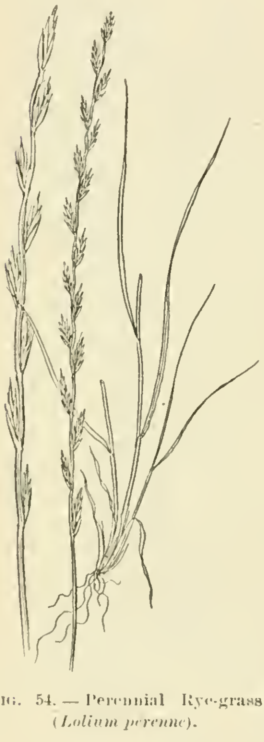


Fig. 54. — Perennial Rye-grass (*Lolium perenne*).

No. 134. Lolium temulentum Linn. Darnel.

An annual grass, 2 to 3 feet high, having a general resemblance to Italian Rye-grass, but usually stouter, more strictly erect, with longer glumes and larger seeds. It has been introduced into this country with the seeds of other grasses, and is occasionally met with in grain fields and about dwellings. The grain contains a narcotic or poisonous principle, which causes eruptions, trembling, and vertigo in man and flesh-eating animals. If the seeds are malted with barley, the ale causes intoxication very suddenly. It is contended by some that perfectly healthy Darnel seeds are innocuous—that only grains which are ergotized or otherwise diseased are injurious.

No. 135. Manisuris. Rat-tail-grass.

The native species of *Manisuris* are branching, leafy perennials, with slender, cylindrical, many-jointed spikes, which readily break up. They are found chiefly in the pine-barren swamps of the Gulf States. They are of little agricultural value in this country. *Manisuris compressa,* a native of southern Asia, south Africa, and Australia, where it is called Mat-grass, has creeping or ascending flattened stems, rather short leaves, and slender spikes. In some parts of Australia it is highly esteemed for pasturage, and is said to retain its greenness throughout the year in dry climates. It is not injured by light frosts. The prostrate stems sometimes attain a length of 5 or 6 feet. A closely related species, *M. fasciculata*, occurs on the lower Rio Grande.

No. 136. Melinis minutiflora Beauv. Molasses-grass.

A sweet and highly nutritious species, and the most esteemed of the grasses of central Brazil, where it is native, growing upon the hills and dry lands. It is regarded a most excellent grass for dairy cows, and deserves a trial in the Southern and Southwestern States and California. The Brazilian names for this grass are "*Capim mellado*" and "*Capim gordura.*" The English name given above is a translation of these. This species occurs also in Ascension Island, Natal, and Madagascar.

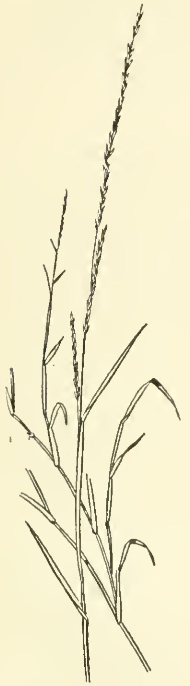


FIG. 55.—Nimble Will (*Muhlenbergia diffusa*).

No. 137. Muhlenbergia diffusa Schreb. Nimble Will. (Fig. 55.)

A low, slender, diffusely branched grass growing on dry hills, in woods, and especially in shady, waste grounds about dwellings. The leafy, wiry stems, which are from 6 to 18 inches long, spring from extensively creeping and rather tough rhizomes, which make a turf very difficult to break up. When young, this grass is readily eaten by all kinds of stock, but after it matures it is so tough that few animals will touch it. It possesses really very little agricultural value, and some look upon it rather as a weed. It is a native from southern New England to Iowa, Michigan, and southward, blooming in the latter part of summer.

No. 138. Muhlenbergia distichophylla Kth. Bearded Saccaton.

This is a strong, firmly rooted grass, 3 to 4 feet high, with rather long and rigid leaves, and a narrow panicle often exceeding a foot in length. It is frequent in the rich valleys in Arizona and New Mexico, and on rich bottom lands it is often cut for hay. It is a coarse grass, like *Sporobolus wrightii*, and by the settlers is classed with it under the general name of Saccaton. In Arizona it forms the more common "hay" that one finds in the towns and way stations, being pulled by the Mexicans or Indians and brought in on the backs of donkeys or on carts. There are many species of *Muhlenbergia* in the south western part of the United States and northern Mexico, and doubtless many of them are of considerable agricultural value. *Muhlenbergia virescens* is a soft and leafy species growing in clumps on the higher slopes of the mountains in Arizona, and with *Poa fendleriana* forms the chief herbage of the so-called "deer parks" of the mountains. (Pringle.)

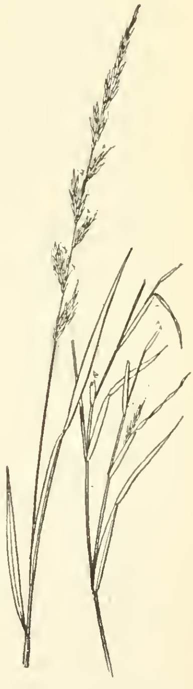


FIG. 56.—Knot-root grass (*Muhlenbergia mexicana*).

No. 139. Muhlenbergia mexicana (Linn.) Trin. Knot-root grass. (Fig. 56.)

A much-branched, leafy perennial, 2 to 3 feet high, with strong, scaly, creeping rootstocks, which often do good service in binding river banks, along which this grass frequently grows. In the Northeastern States this grass is common in low meadows, where it occasionally forms a considerable proportion of the native hay of such places. If cut before the stems have become woody, which they do after flowering, the hay produced is of good quality. It ranges from New England southward to the Gulf and westward to the Rocky Mountains. In the Eastern States it blooms in August.

No. 140. Muhlenbergia porteri Scribn. Wire grama.

This grass is a native of New Mexico and Arizona, growing on the dry mesas and table-lands. It has a straggling habit of growth. The stems are 1 to 2 feet long, much branched, and often matted together. It furnishes excellent feed for cattle in the regions where it grows, and yields good hay, which is harvested in considerable abundance by the ranchmen. It withstands drought very well, but is soon run out under the continued trampling of cattle.

No. 141. Muhlenbergia pungens Thurb. Blow-out grass.

A rather rigid perennial, 12 to 18 inches high, with firm sharp-pointed leaves and open panicles. It has strong, creeping roots, and often does good service as a sand binder. In the sand-hills region of Nebraska it grows abundantly around the borders of the so-called "blowouts," preventing their extension and assisting materially in restoring the turf. In some parts of Arizona where it occurs it is esteemed a valuable forage plant. It grows from Nebraska southward to New Mexico and Arizona, and along the Colorado River above Fort Yuma.

No. 142. Muhlenbergia racemosa (Michx.) B. S. P. Wild Timothy. (Fig. 57.)

An upright, usually sparingly branched perennial, 2 to 3 feet high, with densely flowered, narrow panicles 2 to 4 inches long, often resembling those of timothy. The rootstocks are very tough, and closely covered with thickened scales. It frequents bogs and low grounds from New England westward to the Rocky Mountains, extending southward to Tennessee, New Mexico, and Texas. It is little prized in the East, but in the Northwestern States is recommended as an excellent grass for hay.

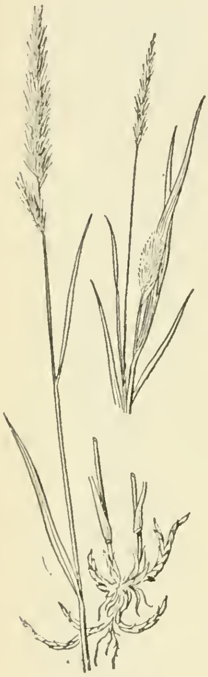


Fig. 57. — Wild Timothy (*Muhlenbergia racemosa.*)

No. 143. Opizia stolonifera Presl. Mexican Lawn-grass.

An extensively creeping, diœcious grass, the very slender, prostrate stems sending up leafy tufts 1 to 4 inches high. Similar in habit to Bermuda, but more delicate. According to Dr. E. Palmer, this is one of the most important grasses of Mexico. Growing close to the ground, it forms a thick sod over all exposed surfaces, even over the cobblestones in the streets of towns. It is used in the public squares with good effect. By regular watering it is easily kept green, and but little cutting is necessary. The seed is difficult to obtain, owing to the constant nibbling of domestic animals. Propagation by cuttings of the rooting, prostrate stems is probably the best method. Trials with this grass ought to be undertaken in the Southern States, both for lawns and pastures.

No. 144. Oplismenus setarius R. & S. Creeping Beard-grass.

A slender perennial of the Gulf States, with decumbent or creeping stems, and short and rather broad leaves. It possesses no recognized agricultural value, but as it grows naturally under the dense shade of trees it might be used for covering the ground in shady places where other grasses will not thrive. It can be propagated by pieces of the stem, which root at the joints, and if cared for, will in a short time make a good turf. A closely allied grass of similar habit of growth, with variegated leaves, is often grown in greenhouses for its ornamental appearance.

No. 145. Oryza sativa Linn. Rice.

A tropical or subtropical, semiaquatic grass, the grain of which is the staple food of one-third of the human race. It is most extensively cultivated in southern Asia, China, and Japan. The annual produce of these countries is estimated at 100,000,000 tons. The rice-growing districts of China support the densest population in the world. In this country rice is cultivated in the States of South Carolina, Georgia, Louisiana, and Texas. The estimate of the crop of cleaned rice produced in Louisiana in 1895 was 82,436,832 pounds. "Paddy" is the grain in the husk. There are many varieties of rice, distinguished by color or size of the grain, absence or presence of beards, etc. There are two classes known as "lowland rice" and "upland rice." The latter is cultivated to some extent in western Tennessee. Rice straw is used for making paper.

No. 146. Oryzopsis asperifolia Michx. Mountain Rice.

A perennial, 6 to 18 inches high, with very long basal leaves overtopping the stems. This grows in rich, open woods, upon hillsides, from New England to Minnesota and northward. It is one of the early blooming species, flowering in May and ripening its seed in June and July. The leaves remain green throughout the winter.

No. 147. Oryzopsis melanocarpa Muhl. Black-fruited Mountain Rice.

A rather stout, long- and broad-leafed grass, 2 to 3 feet high, with a simple panicle of a few rather large spikelets. Grows in rich, rocky woods from New England southward to Pennsylvania and westward to the Rocky Mountains, blooming in July and August. These species of *Oryzopsis* have no recognized agricultural value, but they are very hardy perennials and might be propagated to advantage in woodland parks.

No. 148. Oryzopsis micrantha Thurb. Small Indian Millet.

A perennial, quite widely distributed throughout the central and western counties of the Dakotas and in eastern Montana. It grows in dry, sandy soil, and though tough and wiry, is nutritious and is considered a valuable grass.

No. 149. Oryzopsis miliacea (Linn.) Hack. Many-flowered Millet-grass.

A perennial, 2 to 3 or 4 feet high, with a many- and small-flowered nodding panicle, 6 to 12 inches long. It is a native of central and southern Europe, growing in dry, open woods and thickets. Was introduced into California in 1879, and has been cultivated experimentally with varying success at a number of points in that State. On the granitic soil of San Diego, California, it has grown 3 feet high without irrigation, and remained green throughout the year. Horses and cattle are said to eat it greedily. In Europe it is not regarded as possessing much, if any, agricultural value.

No. 150. Panicularia americana (Torr.) MacM. Reed Meadow-grass.

A stout, erect, leafy perennial, 3 to 4 feet high, with long, rather broad leaves, and a large, nodding panicle. It is common in the northern Middle States and southward along the mountains to Tennessee and North Carolina, extending westward to the Rocky Mountain region. It grows along streams and in moist meadows, and in such places often forms a considerable portion of the native hay. It is liked by cattle and is a good pasture grass for wet lands.

No. 151. Panicularia canadensis (Michx.) Kuntze. Rattlesnake-grass. (Fig. 58.)

A grass similar in habit to the last and growing in similar situations in the Northern States, extending southward to Pennsylvania and westward to Kansas. It is less common than *P. americana*. It has received no attention from the agriculturist. The nodding panicles of rather large spikelets are sometimes gathered for dry bouquets.

No. 152. Panicularia fluitans (Linn.) Kuntze. Floating Manna-grass. (Fig. 59.)

This grass grows to the height of from 3 to 5 feet, and has a narrow panicle composed of rather few long and narrow or cylindrical spikelets. It is a cosmopolitan species, found in all temperate regions of the world, and is regarded as one of the best fodder grasses for swampy meadows. In some parts of Europe the seeds are gathered and used for human food in the form of soups and gruels.

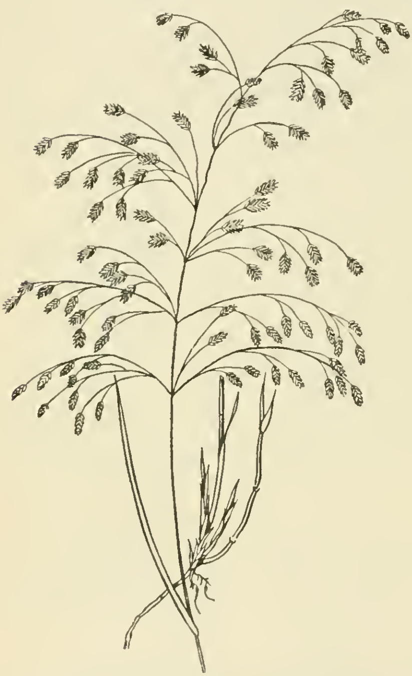


FIG. 58.—Rattlesnake-grass (*Panicularia canadensis*).

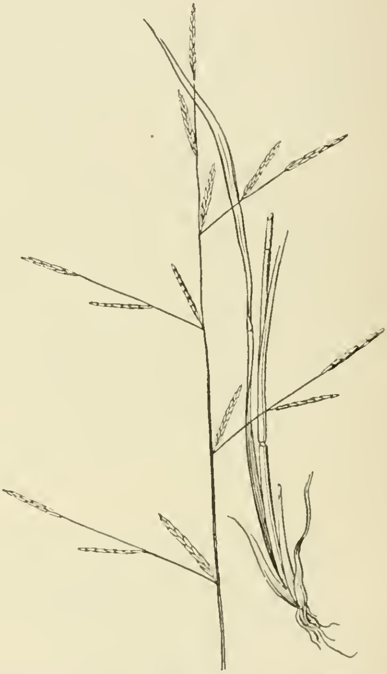


FIG. 59.—Floating Manna-grass (*Panicularia fluitans*).

No. 153. Panicularia nervata (Willd.) Kuntze. Fowl Meadow-grass. (Fig. 60.)

A leafy perennial, 1 to 3 feet high, with expanded nodding panicles of small spikelets. This is a common species in low meadows and moist grounds, extending from New England southward to the Gulf States and westward to the Pacific coast. It is a good fodder plant for moist meadows. Varies greatly in size, according to soil and location. *Panicularia americana* and *Panicularia nervata* furnish food for water fowl during the fall migrations and are valuable in game preserves along with *Zizania aquatica*.

No. 154. Panicum agrostoides Muhl. Munro-grass. (Fig. 61.)

A native perennial, with branching, leafy stems, 2 to 4 feet high, and a panicle resembling that of Redtop. It grows in low meadows and along the banks of creeks, shores of ponds, etc., and often yields a large amount of very good native hay. In low, moist, and rather rich meadows its cultivation would doubtless be profitable, and it is certainly deserving of a trial in such locations.

No. 155. Panicum amarum Ell. Bitter Panic-grass. (Fig. 62.)

A grass of the sandy seacoasts, ranging from Connecticut southward to Florida and along the Gulf. It has coarse, hard stems, 1 to 5 feet high, and strong, creeping rootstocks, making it an excellent sand binder. The islands off the coast of Mississippi are almost wholly made up of drift sands, the outer sides being dunes from 10 to 30 feet high, while the middle of the islands is usually low and occupied by swamps or lakes. This bitter panic is very abundant upon the outside of these dunes, where it is exposed to the winds and waves, and where it serves to effectually bind the otherwise shifting sands. The leaves and stems have a bitter taste, hence the common name.

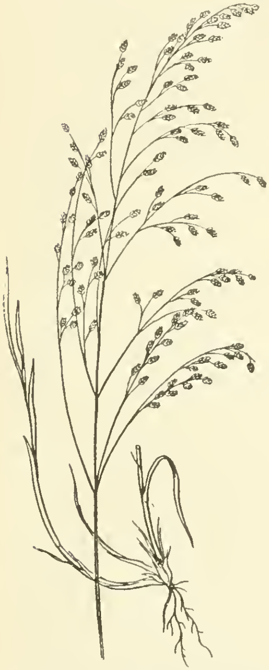


FIG. 60. -Fowl Meadow-grass (*Panicularia nervata*).

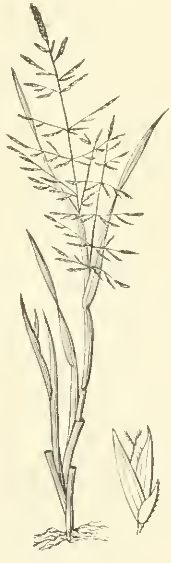


FIG. 61.—Munro-grass (*Panicum agrostoides*).

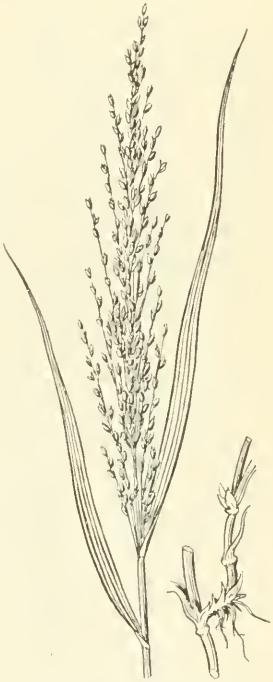


FIG. 62.—Bitter Panic-grass (*Panicum amarum*).

No. 156. Panicum capillare Linn. Old Witch-grass.

An annual, with usually coarse, branching stems, 1 to 3 feet long, hairy leaf sheaths, and widely spreading panicles. Grows in cultivated grounds, where it often becomes a somewhat troublesome weed. Being an annual, however, it is easily eradicated. Possesses no value for fodder excepting for fall feed on stubble.

No. 157. Panicum ciliatissimum Buckl. Indian Wheat.

A more or less extensively creeping perennial, with short leaves and upright flowering stems, 6 to 18 inches high. The panicles are narrow and few flowered, and in the prostrate forms usually partly included within the leaf sheaths. This grass is a native of western Texas, and doubtless possesses some agricultural value for the drier regions of the Southwest. The creeping stems resemble somewhat those of Bermuda-grass, but the leaves are usually more crowded and broader in proportion to their length.

No. 158. Panicum colonum Linn. Shama Millet.

A native of the tropical and warmer temperate regions of the Old World. In northern India it is considered one of the best fodder grasses. Introduced into the Southern and Southwestern States, where it is occasionally found in waste grounds about dwellings. It is closely related to *Panicum crus-galli*, differing from that grass in its smaller size and more simple inflorescence. The stems and leaves are tender and readily eaten by stock. In India the grain, which is produced abundantly, is sold in the markets and used for food.

No. 159. Panicum crus-galli Linn. Barnyard-grass. (Fig. 63.)

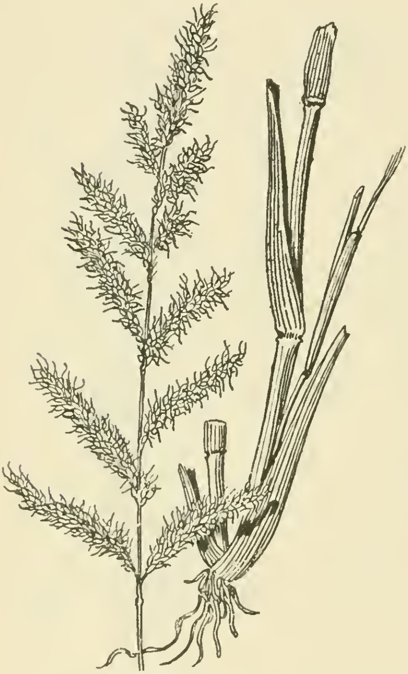


Fig. 63.—Barnyard-grass (*Panicum crus-galli*).

This well-known annual of rank growth is common in rich, cultivated ground, especially around dwellings. There are several forms presented by this species. That growing as a weed around barnyards and dwellings, in cultivated grounds in the Atlantic States, was probably introduced from Europe. There are, however, several native varieties, or possibly good species. One of these occurring in the brackish marshes or meadows along the seacoast, grows to the height of 3 to 5 feet, with the lower leaf sheaths very hirsute, and the spikelets long-awned. A tall, smooth form occurs in New Mexico, Arizona, and the Mohave desert region, springing up after the summer rains in all swampy places or lowlands. It grows to the height of 6 or 7 feet, and its seeds, which it produces abundantly, are collected by the Mohave Indians, ground into flour, and cooked for food. The poorer classes of India also use the grain for food. A variety introduced from Japan has been cultivated at some of the experiment stations and treated as a millet. At the Hatch Experiment Station, in Massachusetts, the crop produced was very uniform, averaging 7 feet in height. The yield was at the rate of 11,207 pounds of straw per acre and 66.7 bushels of seed. When sown for silage or for soiling at the rate of one peck of seed to the acre, the yield was at the rate of from 15 to 18 tons per acre. A field sown July 26, after a crop of hay was removed, yielded 12 tons per acre. It is very much liked by stock, and is a valuable forage plant for feeding green or for the silo. It is not so well adapted for hay, as it is a coarse, succulent grass, and rather difficult to dry.

No. 160. Panicum digitarioides Carpenter. Maiden Cane.

A rather coarse grass, 2 to 4 feet high, growing along ditches, in swamps, and in moist sands from Delaware southward to Florida and along the Gulf near the coast. It has strong and widely spreading or creeping rootstocks, which are useful in binding sandy railroad embankments in the Southern and Gulf States.

No. 161. Panicum fasciculatum Sw. Brown-top.

A rather coarse and much-branched leafy annual, growing in clumps to the height of 2 to 3 feet. The leaves are flat, one-fourth to one-half an inch wide, and 2 to 6 inches long. It is a native of Texas and Florida. Similar in character and closely allied botanically to *Panicum texanum*.

No. 162. Panicum lachnanthum Torr. Arizona Cotton-grass.

This is a native of the dry regions of Arizona and New Mexico. It resembles *Panicum lanatum*, but has more slender stems, which rise from strong, woolly, and knotted rootstocks. This may prove to be a valuable pasture grass for the dry or semiarid regions of the Southwest.

No. 163. Panicum lanatum Rottb. Cotton-grass.

A variable species widely distributed throughout the tropical regions of both hemispheres. It is a perennial with slender or stout stems 1 to 3 feet high, usually with flat leaves and narrow panicles, the spikelets being densely clothed with long silky or cottony hairs, which are white, or sometimes brownish or purplish. When abundant this grass yields excellent pasturage. It has been found in southern Florida and at other points near the Gulf coast. There is a variety of this species growing in the dry regions of Arizona and New Mexico which has more slender stems, that spring from strong woolly and knotted rhizomes. Doubtless this form would be a valuable pasture grass for the dry or semiarid regions where it is native.

No. 164. Panicum maximum Jacq. Guinea-grass. (Fig. 64.)

This grass was long ago introduced into America, presumably from tropical Africa, and has for many years been cultivated in tropical South America and the West Indies. In these regions it is spoken of as being a splendid pasture grass, growing to the height of 12 feet, forming dense tufts. It is readily propagated by cuttings of the creeping rootstocks. It has been introduced into some of the Gulf States, particularly Florida, where it is highly valued. Few grasses yield a larger amount of fodder, and it may be cut as often as once a month during the growing season. If allowed to attain its full size it becomes coarse and unfit for forage. Its stems are killed by the first frosts of autumn. It seeds only in the warmest parts of the States bordering the Gulf. It is much less hardy than Johnson-grass, with which it has been confounded by some, and has quite a distinct habit of growth.

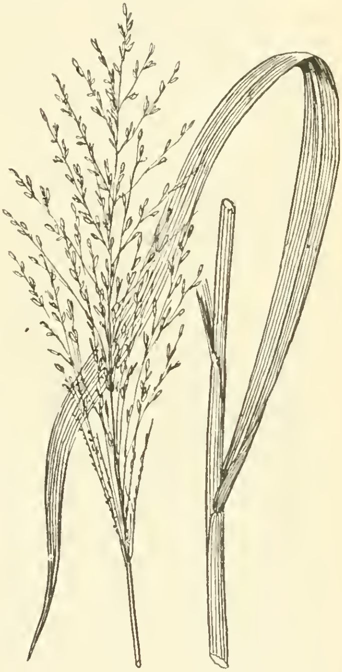


Fig. 64.—Guinea-grass (*Panicum maximum*).

No. 165. Panicum miliaceum Linn. Broom-corn Millet.

A rather coarse annual, attaining a height of 2 to 4 feet, with large, drooping, loosely flowered panicles. There are several varieties, distinguished by the color of the fruit or character of the panicle. This is the true millet which has been cultivated in the East from prehistoric times, so that now its native country is not known. It is still cultivated to a considerable extent in China and Japan, also in South Russia and Roumania, and to a limited extent in other parts of Europe and North Africa. It requires a rich soil, and under favorable conditions its growth is very rapid and its production of seed large, in some instances amounting to 60 or 70 bushels to the acre. The grain is nutritious, and is one of the best for feeding poultry. When ground, the flour makes a rich and nutritious porridge, for which purpose it is chiefly used in the eastern countries where the grass is grown. In northern India, where the grain is largely used, a preparation of it constitutes a favorite food at marriage ceremonies. Owing to its rapid and somewhat succulent growth, it is an excellent soiling plant. It has, however, been little cultivated in this country, but is occasionally found in the older settlements in cultivated fields and waste grounds about dwellings. The number of grasses termed millets in various parts of the world is large, and includes many very different species, whose grain, however, is used for human food. Most of the so-called millets belong to the genera *Chætochloa*. *Panicum*, and *Paspalum*. They form the principal food grains of the natives of many parts of Africa and Asia. It has been estimated that the millets feed one-third of the human race.

No. 166. Panicum molle Sw. Para-grass.

A rather coarse, reed-like perennial, 4 to 6 feet high, with hairy nodes, and narrow, lax panicles, 6 to 8 inches long. It is cultivated in South America, and in the West Indies and Mexico, and has been introduced into some of the Gulf States. It is grown with success on the high pine ridges of Florida, and wherever cultivated it is most highly esteemed and regarded as a very fattening pasture grass. How far to the north this grass may be grown successfully does not appear to have been determined, but it is hardy at the Cape of Good Hope and other far extra tropical regions (Baron von Mueller). It is propagated either by seeds or root cuttings.

No. 167. Panicum obtusum H. B. K. Vine Mesquit.

A stoloniferous grass, the runners attaining a length of 8 to 10 feet, the upright flowering culms 12 to 24 inches high. This grass ranges from Colorado to Texas, New Mexico, Arizona, and southward into Mexico. It is usually found in irrigated lands or in the low, damp soil of the valleys, most frequently under the shade of trees and shrubs. No attempts have been made to cultivate this grass, but its appearance and habit of growth indicate an agricultural value of sufficient importance to call for experiments in its cultivation. In New Mexico this species is called "Wire-grass."

No. 168. Panicum plicatum Lam. Palm-leafed Grass.

A broad-leafed perennial, 3 to 4 feet high or more, native of India. The leaves are elegantly striate and usually plicate, giving to the grass an unusual and at the same time attractive appearance. It is a favorite ornamental for greenhouse culture.

No. 169. Panicum proliferum Lam. Sprouting Crab-grass.

A smooth and usually much-branched native annual, with rather coarse, spreading or ascending stems 2 to 6 feet long, flat leaves, and diffuse terminal and lateral panicles. It grows naturally in moist, rich soil along the banks of streams and rivers, around the shores of ponds and lakes, and in the South is often abundant in rich, cultivated fields, growing with Crab-grass. The stout, succulent stems are sweetish and much liked by horses and cattle. Its range is from Maine to Nebraska, and southward to the Gulf, blossoming in the latter part of summer or early autumn. The spontaneous growth of this grass in cultivated fields after the removal of crops is of some value for hay or pasturage, but its cultivation can not be recommended in view of the fact that we have many annual grasses much superior to it. In the Northern and Middle States it is classed with the weeds.

No. 170. Panicum repens Linn. Creeping Panic.

An extensively creeping grass, with rather stiff upright stems, 1 to 2 feet high or less. It is common in the maritime districts in southern Asia, northern Africa, southern Europe, and Australia. It is also found along the shores of the Southern States bordering the Gulf, extending westward to Mexico. It has no agricultural value, but is a natural sand binder. Upon the sandy islands lying off the Gulf Coast it grows abundantly upon the outside of dunes, protecting them from the action of the winds and waves.

No. 171. Panicum sanguinale Linn. Crab-grass. (Fig. 65.)

A well-known annual, common in nearly all parts of the United States, growing in cultivated fields and about dwellings. It is a weed in gardens and among hoed crops. In grain fields after harvest it frequently springs up in such quantity, particularly in the Southern States, as to yield one or even two good cuttings of hay. This spontaneous growth affords excellent pasturage, as well as hay of first quality if properly cured. The stems are much branched, and in good soil attain a length of 3 to 4 feet. This grass contains little fiber, and dries quickly when cut, but if after cutting it is wet by rains or heavy dews its value for hay is almost wholly destroyed. In Bohemia, Crab-grass is cultivated upon sandy soils and the grain is used for food in the form of mush or porridge.

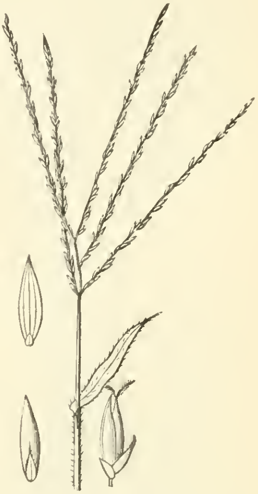


Fig. 65.—Crab-grass (*Panicum sanguinale*).

No. 172. Panicum serotinum (Michx.) Trin. Little Crab-grass. (Fig. 66.)

A species related to Crab-grass (*Panicum sanguinale*), common in the Southern States near the Gulf, disputing with Louisiana-grass the claim of being the most valuable native pasture grass of that section. It is probably a biennial. It is much like Crab-grass, sending out leafy, creeping shoots at every joint, but is smaller in every way, with shorter and more hairy leaves of a lighter green color. It is invaluable for pasturage, forming a close turf, and driving out nearly all other plants. It grows best in sandy soil where there is a little moisture.

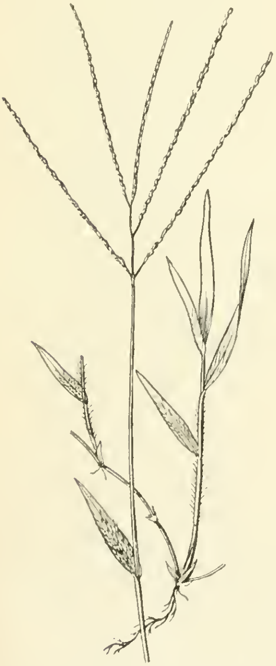


Fig. 66.—Creeping Crab-grass (*Panicum serotinum*).

No. 173. Panicum spectabile Nees. Angola-grass.

A stout grass, 3 to 5 feet high, with rather broad and long (1 to 2 feet) leaves, and a terminal, densely flowered, compound and narrow spike 8 to 10 inches long. Imported into South America many years ago from the west coast of Africa (the region of Angola). It is cultivated on the low lands in the eastern part of Brazil, particularly in the region of Rio de Janeiro, where it is called "Capim d'Angola." This Panicum is closely related to and resembles some forms of Barnyard-grass (*P. crus-galli*). It is spoken of as an extremely productive and nutritious fodder-grass, and may prove valuable for the low regions along the Gulf coast.

No. 174. Panicum sulcatum Aubl. Palm-Leafed-grass.

A South American perennial, 4 to 6 feet high, with palm-like leaves 1 to 2 inches broad and 16 to 20 inches long, and long, terminal, narrow panicles which taper above and below. The leaves of this grass are deeply sulcate or plicate, like those of the Indian *P. plicatum.* Sometimes cultivated for ornament in greenhouses or upon lawns.

No. 175. Panicum texanum Buckl. Colorado-grass. (Fig. 67.)

A branching, leafy annual, 2 to 4 feet high, with a narrow panicle 6 to 8 inches long terminating the main stem and branches. It is nutritious, of rapid growth, and upon good soil yields a large amount of excellent hay, and may be cut twice or even three times during the season. It reseeds itself readily. It prefers rich, alluvial soil along river bottoms, etc., and upon such land withstands drought well. In certain parts of Texas, particularly in the counties along the Colorado River, in the central part of the State, where it appears to be native and where it often comes up in cultivated fields after the removal of corn or other grain crops, it is spoken of in the highest terms as a hay-producing grass.

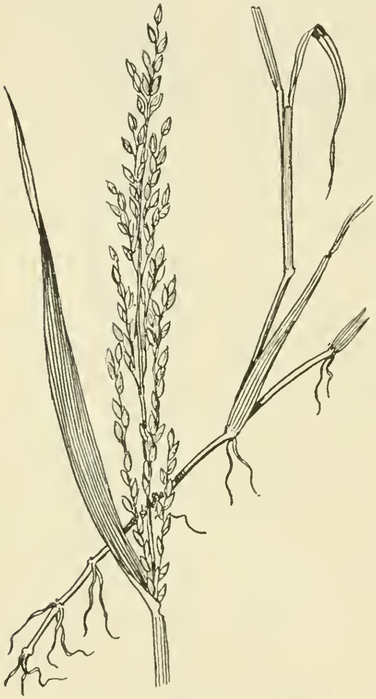


Fig. 67.—Colorado-grass (*Panicum texanum*).

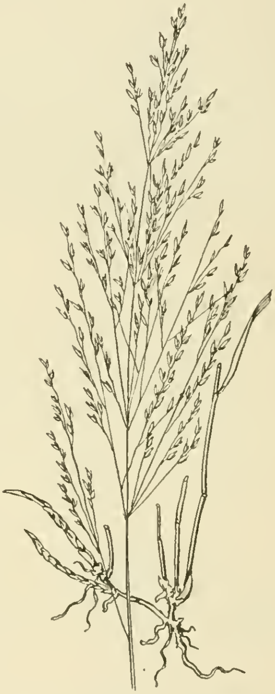


Fig. 68.—Switch grass (*Panicum virgatum*).

No. 176. Panicum virgatum Linn. Switch-grass. (Fig. 68.)

A tall, native perennial, 3 to 5 feet high, with strong, creeping rootstocks, long, flat leaves, and ample, spreading panicles. When young this affords good grazing, but at maturity the stems become hard and practically worthless for fodder. It ranges from Maine southward to the Gulf and westward to the Rocky Mountains. It is particularly common near the coast in sandy soil bordering the marshes, and oftentimes plays an important part there, in preventing the drifting of sands by the winds or the washing of soils by overflows and high tides. On good lands it is very productive, and if cut before the stems have become hard yields a large amount of hay of very good quality.

No. 177. Pappophorum laguroideum Schrad.

A handsome ornamental, 3 to 5 feet high, with narrow, plume-like panicles a foot or more long. It is a native of Mexico, and has been successfully grown from seed on the grounds of the Department of Agriculture. It is worthy of introduction as an ornamental for gardens and lawns because of the beauty of its pale straw-colored panicles.

No. 178. Pappophorum wrightii S. Wats. Purple-grass.

A slender and apparently annual grass of western Texas, New Mexico, and Arizona, growing on the open plains and among the foothills of the mountains. It has short, narrow leaves and narrow, densely flowered heads or panicles, which are softly bearded and grayish or purplish. It is said to be fully equal to Grama or Buffalo-grass in nutritive value, and more palatable to horses or mules.

No. 179. Paspalum boscianum Flügge. Purple Paspalum.

A rather stout perennial with ascending branching stems, 2 to 3 feet high, long, flat leaves, and numerous racemes crowded near the summit of the culm and its branches. It is a native of the Southern States, growing in moist grounds, preferring rather heavy soils. Like other species of Paspalum, it grows in tufts and often occurs covering considerable areas to the exclusion of other grasses. It yields a good bulk of sweet hay, but is rather slow in drying.

No. 180. Paspalum compressum (Sw.) Nees.

A slender, erect, or more frequently prostrate and extensively creeping perennial, rooting at the nodes, and sending up numerous leafy, flower-bearing branches, 6 to 24 inches high. The very slender racemes or spikes borne at or near the summit of the stems are 1 to 3 inches long. The prostrate creeping stems spread rapidly, and soon form a dense, carpet-like growth, crowding out all other vegetation. It withstands protracted drought, grows well on almost any soil, and in the more southern districts is evergreen, yielding good pasturage both summer and winter. It is regarded as one of the most valuable native pasture grasses of the regions bordering the Gulf, and is a most excellent lawn grass, superior to Bermuda and less difficult to eradicate. It is found in the warmer regions of both North and South America. It is readily propagated by sets and seeds.

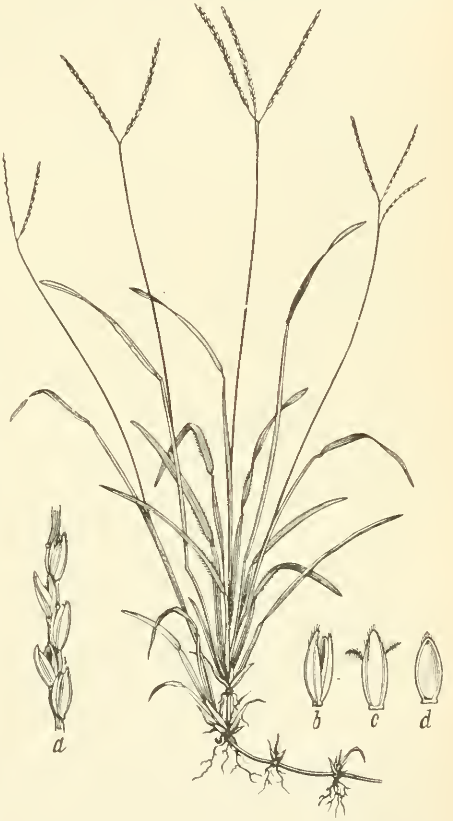


Fig. 69.—Carpet-grass (*Paspalum compressum*): *a*, attachment of spikelets to rachis; *b* and *c*, spikelets; *d*, floret.

No. 181. Paspalum dilatatum Poir. Large Water-grass.

A rather coarse leafy perennial, growing in clumps 2 to 5 feet high, bearing near the summit of the stems two to ten, more or less spreading racemes or spikes of crowded, hairy spikelets. It is a native of Brazil and possibly was originally introduced into the Southern States (where it has become quite widely distributed) from that country, although it may be a native here. It ranges northward from the Gulf to southern Virginia and Tennessee, and westward to Texas, growing most abundantly on low, black soils, which are well supplied with moisture. It is considered an excellent pasture grass, and when well established endures seasons of excessive drought without injury. It is particularly valuable as furnishing excellent late summer and autumn feed, during which period it makes its principal growth.

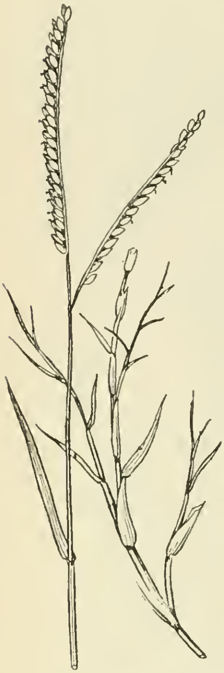


FIG. 70.—Knot-grass (*Paspalum distichum*).

No. 182. Paspalum distichum Linn. Knot-grass. (Fig. 70.)

A low creeping species, resembling Bermuda-grass. It is common in the Southern States along the seacoast and in the interior, extending southward from Virginia to the Gulf, and westward to Texas, Arizona, southern California, and northward to Oregon. It occurs throughout the tropical regions of both the Old and New Worlds. It grows in more or less sandy soils around the margins of ponds and along river banks. In such places it often does good service in binding soils subject to wash. The grass can well be recommended for this use. Its stems are somewhat succulent, extensively creeping, rooting at the nodes. The leaves are tender, affording excellent grazing. The upright stems are a few inches to a foot high, and bear at their summits two slender spikes. This character at once serves to distinguish it from Bermuda, which has several spikes at the apex of the flowering culms.

No. 183. Paspalum læve Michx. Smooth Paspalum. (Fig. 71.)

A tufted native perennial, with ascending or erect stems, 1 to 3 feet long, flat leaves, and two to five, more or less spreading spikes, 2 to 4 inches long. Common in the Middle and Southern States, growing in open fields, meadows, etc., usually where the ground is somewhat moist. It is a late summer grass, blossoming from July to October. Well liked by all kinds of stock. In cultivated grounds, and particularly on lawns, which it occasionally invades, it must be classed as a weed.

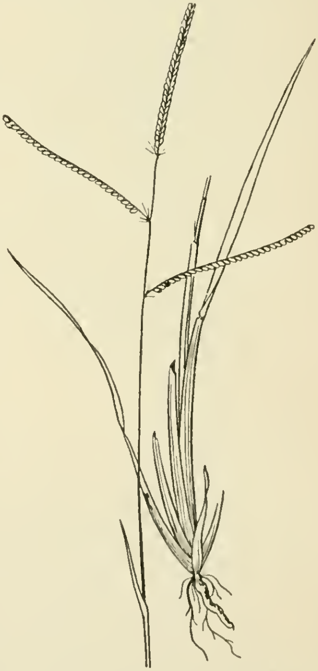


FIG. 71.—Smooth Paspalum (*Paspalum læve*).

No. 184. Paspalum scrobiculatum Linn. Ditch Millet.

A smooth annual, with branching, erect or ascending stems, 2 feet high or more. Widely distributed throughout the tropical and subtropical regions of both hemispheres. In northern India this grass is cultivated throughout the plains-region as a "rainy-season crop." It is usually sown on the poorer kinds of soil, the grain being chiefly consumed by the lower classes. The straw is used for fodder. (Duthie.) A variety of *P. scrobiculatum*, called "hureek" in India, which is perhaps the Ghohana-grass, an Indian species reputed poisonous, is said to render the milk of cows that graze upon it narcotic and drastic. (Lindley.)

No. 185. Pennisetum japonicum Trin.

Erect, with flattened simple stems, 1 to 2 feet high, very narrow leaves, and comparatively loosely flowered purplish or yellowish nodding panicles. A native of Japan. Occasionally cultivated as a curiosity or for ornament.

No. 186. Pennisetum latifolium Spreng.

A rather broad-leafed ornamental perennial, 3 to 5 feet high, branching above, with greenish rather dense panicles 1½ to 2 inches long. Native of Uruguay and Argentina. In the latter country it is used for covering roofs of houses. Occasionally found cultivated here as an ornamental grass. It forms large tufts and is easily propagated by the roots or seeds. It may possess some value as a forage plant.

No. 187. Pennisetum macrourum Trin.

A South American species, with unbranched stems, 3 to 4 feet high, and densely flowered, cylindrical, yellowish panicles 6 to 8 inches long. Cultivated occasionally for its odd and ornamental appearance.

No. 188. Pennisetum spicatum. Pearl Millet.

An annual of luxuriant growth, 6 to 10 feet high, with long, broad leaves, stout culms, and terminal, erect, cylindrical, dense spikes 6 to 12 inches long, closely resembling those of the common cat-tail of the marshes. It is a native of the East, where it has been cultivated for its grain for many years. It is an important agricultural grass of Central Africa. It requires a rich loose soil to obtain the best growth, and under favorable conditions produces an enormous quantity of green fodder, for which purpose it can be cut several times during the season. It does not dry out readily and is often difficult to cure into hay. It has been cultivated with success as far North as Pennsylvania and in many parts of the South for a good many years. It is best sown in drills, about 2 feet apart, and 5 to 6 pounds of seed are required per acre. The weight of good seed per bushel is 56 pounds. The current price is $12 to $14 per 100 pounds.

No. 189. Pennisetum villosum Brown.

An Abyssinian species which has been introduced into cultivation because of its ornamental appearance. It grows to the height of 1 or 2 feet, has long narrow leaves, and dense, oblong or cylindrical, finely bearded heads 2 to 4 inches long. It is a hardy perennial, graceful and attractive in appearance, and is very frequently cultivated as an ornamental under the name of *Pennisetum longistylum.*

No. 190. Phalaris arundinacea Linn. Reed Canary-grass. (Pl. III, fig. 3.)

A tall, leafy perennial, 2 to 4 feet high, from a creeping rootstock, with smooth sheaths and narrow, branching panicles 4 to 8 inches long. It is a native, common on low, wet grounds, from New England southward to Tennessee, and extending across the continent to California and Washington. It is native also in Europe and northern Asia. It is little affected by either drought or cold, and thrives well in the shade. It succeeds best on stiff, wet land, and on wet, flooded fields and will grow fairly well upon rather dry, sandy soil. The rootstocks are very strong and creep extensively, making this grass particularly valuable for binding banks of rivers and ditches where the water supply is ample. It does not attain its full size until the second year, and if designed for hay should be cut before flowering, for when fully mature the stems become woody and are too hard to make good fodder. The seed, which matures in July and August, is easily gathered. Good seed should have 95 per cent purity and 60 per cent germination. It may be propagated by seed or by cuttings of the rootstocks, these being laid down at intervals of 1 foot, and slightly covered. The retail price of seed quoted in the New York market is $35 per 100 pounds. A variety with white-striped leaves, called Ribbon-grass, is cultivated in gardens for ornament.

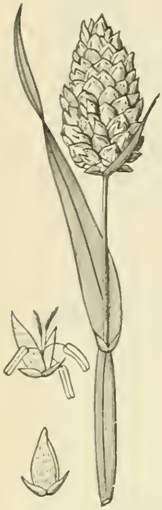


Fig. 72.—Canary-grass (*Phalaris canariensis*).

No. 191. Phalaris canariensis Linn. Canary-grass. (Fig. 72.)

An erect annual, 1 to 3 feet high, with flat leaves, and dense, ovoid panicles or heads about an inch long. This grass is apparently a native of the warmer countries of Europe, also of north Africa and western Asia. It has become widely distributed throughout the warmer temperate and tropical regions of the world, including Australia. Cultivated in Germany and southern Europe. It has been introduced into this country, and is occasionally cultivated for its seeds, which are used for bird food. The flour from the seeds is utilized in certain processes of cotton manufacture (weaver's glue), and is even employed in the making of some kinds of cake. It is frequently met with in waste grounds about dwellings in the vicinity of towns.

No. 192. Phalaris caroliniana Walt. Southern Canary-grass; Apache Timothy.

This and *Phalaris angusta* (Fig. 73) have usually been regarded as one species, the latter as a variety with more elongated heads and rather stouter growth. Both the species and variety are perennials, ranging from South Carolina to Florida and westward to Texas, Arizona, California, and northward on the Pacific slope to Oregon. *Phalaris angusta*, a stout grass, 2 to 5 feet high, is sometimes called Apache Timothy, owing to the resemblance of its heads to those of timothy. In California it is not esteemed as of any agricultural value, but in the Southern States it has been cultivated to a limited extent, and is spoken of by some a being an excellent grass for winter and spring grazing, as it remains green throughout the winter season.

No. 193. Phleum alpinum Linn. Mountain Timothy.

This grass is a native of the mountain regions from Maine to California and northward; also in northern Europe and Asia. It is closely related to cultivated timothy. The stems are usually stouter, more leafy, but not so tall, under most favorable conditions attaining a height of 2 feet, but rarely exceeding a foot.

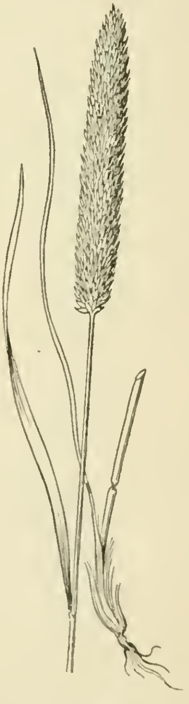


Fig. 73.—Apache Timothy (*Phalaris angusta*).

No. 194. Phleum pratense Linn. Timothy. (Fig. 74.)

This is one of the best known and most extensively cultivated hay grasses. It is a native of Europe (where it is known as cat's-tail), north Africa, and northern and middle Asia, and has become thoroughly naturalized in North America. It appears to have been first cultivated in this country, and it was from this country that the seeds were obtained for its cultivation in England about the year 1760. It has never attained the same high esteem in England that it holds here, where it is regarded as the standard of comparison for all other grasses grown for hay. It succeeds best on moist loams or clays. In very dry ground the yield is apt to be light. On such soils the base of the stem is often thickened and bulb-like. Timothy is usually sown in mixtures with other grasses and clovers. It may be used with red or alsike clovers, or with redtop. Good fresh seed should have an average purity of 97 per cent and a germinative power of 85 to 90 per cent, a bushel weighing 48 pounds. The amount required per acre varies with the quality of the seed, but of that containing 87 per cent pure in germinating, 16 pounds to the acre is sufficient. It is better, however, to sow half a bushel to the acre if sown alone. With red or alsike clovers about 10 per cent timothy is a proper mixture.

No. 195. Phragmites vulgaris (Lam.) B. S. P. Common Reed.

This is one of the largest of our native grasses, growing to the height of 12 feet, the rather stout culms bearing numerous broad, spreading, and sharply pointed leaves 1 to 2 feet long. It has deeply penetrating and extensively creeping rootstocks, making it one of the most valuable grasses for binding the banks of rivers subject to periodical floods. It is occasionally found along the coast in brackish marshes and sometimes upon sandy soils, and possibly may be employed with advantage for binding drifting sands or those liable to be shifted by high tides. The rootstocks are very strong, and when the grass is once established scarcely anything can remove it. The young shoots are liked by cattle and the mature stems make the best of thatch. It is very widely distributed throughout the temperate regions of both hemispheres, growing along river banks, borders of lakes, etc.

No. 196. Poa alsodes A. Gray. Wood Spear-grass.

A slender, erect perennial, 1 to 3 feet high, with flat leaves and a narrow, rather few-flowered panicle. It is a native, growing upon the wooded hillsides of New England, extending westward to Wisconsin, and southward through New York, Pennsylvania, and Virginia, to the mountain regions of North Carolina and Tennessee. It possesses no recognized agricultural value, but is apparently a good fodder grass, and may possibly prove of value in cultivation in woodland parks. Other closely related species of *Poa* extend westward across the continent.

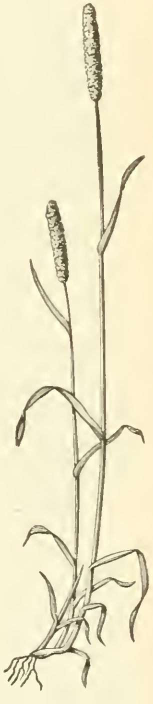


FIG. 74.—Timothy (*Phleum pratense*).

No. 197. Poa annua Linn. Low Spear-grass.

A low, spreading annual, with erect or ascending somewhat flattened stems, 2 to 12 inches high. This is an introduced grass, common in every dooryard and about dwellings and cultivated grounds. It may be found in bloom in the Southern States in almost every month in the year. It often forms a considerable ingredient in poorly kept lawns, as a result of its spontaneous growth.

No. 198. Poa arachnifera Torr. Texas Blue-grass.

A strong-growing perennial, 1 to 3 feet high, with extensively creeping rootstocks, long leaves, and narrow, densely flowered panicles. This grass is apparently diœcious. The pistillate or seed-bearing plants have the spikelets densely woolly, while the male spikelets are smooth. It is a native of Texas, but is now well known in most of the Southern States, where it has been introduced into cultivation, having been highly recommended as a permanent pasture grass. It may be propagated by seeds or "root cuttings," which can be obtained from leading seedsmen. It makes its principal growth during the winter months, coming into bloom in the latter part of April or early in May. It makes a good sod and withstands well the heat of summer and protracted drought. Owing to the woolliness of the seeds, they are difficult to sow, and as they are rather expensive this grass has not been so extensively propagated as it otherwise would have been. A somewhat troublesome, but more certain, method of propagation is by root cuttings. These may be planted at any time during the fall or early spring months, being set out in rows 2 feet apart and 6 to 10 inches apart in the rows. The retail price of the seed, according to New York catalogues, is $3 per pound.

No. 199. Poa arida Vasey. Bunch Spear-grass.

A smooth, upright perennial, 1 to 2 feet high, with rather rigid, sharp-pointed leaves, and a close or narrow panicle 2 to 3 inches long. This grass is a native of the Rocky Mountain region, from the British Possessions southward to Arizona. It has short, creeping rootstocks, and although more rigid than many species of *Poa*. is one of the most valuable pasture grasses of the dry regions of the West.

No. 200. Poa buckleyana Nash. Bunch Red-top. * (Fig. 75.)

Rather slender, 1 to 2 feet high, with no creeping rootstock, very narrow root leaves, and contracted panicles of usually purplish spikelets. It is a perennial, and a native of the Rocky Mountain regions, growing on the lower foothills and in the valleys. It grows in bunches, not forming a turf, and is regarded by the ranchmen as one of the most valuable "bunch grasses" of the cattle ranges. It has never been introduced into cultivation, but is deserving of attention, for it responds readily to improved conditions, and when growing along streams or in irrigated land makes a luxuriant growth of foliage, and often attains a height of 2 or 3 feet. There are many species of *Poa* native to the northern portion of our country, particularly in the Northwest, and all are tender, nutritious pasture grasses. Wherever grasses grow, from the seashore to the highest mountain tops, from one arctic zone to the other, the genus *Poa* has its representatives.

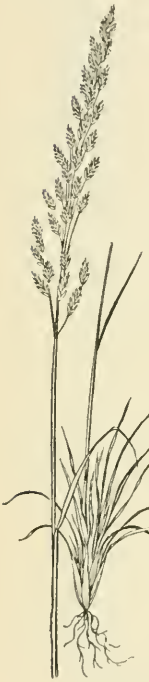


FIG. 75.—Bunch Red-top (*Poa buckleyana*).

No. 201. Poa compressa Linn. Canadian Blue-grass.

A slender perennial, with much-flattened stems, 6 to 20 inches high, and small, narrow panicles. This grass has extensively creeping rootstocks, and forms a strong turf. It is a native of Europe, which has become thoroughly naturalized, and is now very widely distributed over our territory. It is closely related to Kentucky Blue-grass, but it is more decidedly blue in color, and is readily distinguished from that species by its strongly flattened stems, lower habit of growth, and smaller panicle. It is the "Blue-grass" of the farmers of the New England and Middle States. It will grow upon a great variety of soils, even upon those so poor and thin as to exclude the growth of other grasses. In cultivated lands it is likely to become troublesome, owing to its creeping rootstocks. There is perhaps no better pasture grass for dry and poor soils, particularly in the Eastern and Middle States. It is especially valuable for dairy pastures; cows feeding on it yield the richest milk and finest butter. On good land it becomes sufficiently tall for hay, and as it shrinks very little in drying, the hay is heavy in proportion to its bulk. Seed is advertised by leading firms at $14 per 100 pounds.

No. 202. Poa fendleriana (Steud.) Vasey. Mutton-grass.

Widely distributed in the Rocky Mountain region and on the Pacific Slope, extending southward through Arizona into Mexico. It grows in tufts to the height of 1 to 2 feet, has numerous long root-leaves, and short, compact heads or panicles. It is tender, and affords a large amount of excellent grazing in the regions where it grows abundantly, and may prove a valuable acquisition to the forage grasses of the Atlantic States.

No. 203. Poa flabellata Hook. Tussock-grass.

A native of the Falkland and adjacent islands, which has attracted the attention of travellers by its stout habit of growth and evident nutritious qualities. The flowering stems are 5 to 8 feet high, and these are often exceeded by the numerous radical leaves. This grass grows in great tussocks, 1 to 4 or 5 feet across. The stems and long leaves are used for thatch. "It loves a rank, wet, peat bog, with the sea spray dashing over it, and wherever the waves beat with greatest vehemence and the saline spray is carried farthest, there the tussock grass thrives the best, provided, also, it is on the soil it prefers." It thrives in cold countries near the sea in pure sand at the edge of peat bogs. The base of the stem is edible, having a taste of mountain cabbage, a species of palm. The introduction of this grass to certain points along our Northern seaboard, where other grasses will not thrive or where there is danger of encroachment upon the land by the sea, may be desirable. The nutritious qualities of the grass and its furnishing good fodder the year round upon the Falkland Islands has been repeatedly noted by authors.

No. 204. Poa flava Linn. False Red-top.

A native of northern Europe and the northern portions of our own country, growing naturally in wet meadows and along the low banks of streams. It attains the height of 2 to 3 feet, or even 4 feet in rich, moist soils, and has an expanded, nodding panicle of rather small, purplish, or "bronzed" spikelets. It is found in nearly all parts of New England, and often forms a very considerable and valued portion of the native hay of the low meadows. It has been cultivated to some extent, but should only be used in mixtures, as it does not make a good sod when sown alone. It blooms in July and August.

No. 205. Poa nemoralis Linn. Wood Meadow-grass.

The larger forms of this are hardly to be distinguished from *Poa flava*, and have a similar range. It will, however, grow in a drier soil, excessive moisture being harmful to it. In Montana this species ascends to the altitude of 9,000 feet. At this elevation it is dwarfed in habit, but at lower elevations it becomes taller and affords excellent forage. There are several varieties of this grass in the Rocky Mountains and the Northwest, some of them growing upon the dry foothills and bench lands. The larger forms are well adapted for hay. It is less productive than many others, and its cultivation is not recommended, excepting in shady parks or open woodlands where an increase of forage is desired, or in shaded lawns, and then only in the Northern and Middle States.

No. 206. Poa nevadensis Vasey. Nevada Blue-grass.

A perennial bunch grass from the western prairie and plains regions. It grows on both dry and damp soils, produces a large amount of excellent hay, and is apparently worthy of cultivation.

No. 207. Poa pratensis Linn. Kentucky Blue-grass. (Fig. 76.)

This is apparently native throughout the temperate regions of the northern hemisphere. It ranges from Labrador to South Carolina, westward to the Pacific coast and northward to Alaska. In the limestone regions of Kentucky and Tennessee it attains its greatest perfection and is there regarded as the king of pasture grasses. It requires a good soil containing some lime in order to yield profitable crops. It is largely employed in the Eastern and Middle States as a lawn grass, for which use it is well adapted. It makes a good, firm sod, and is particularly well suited for turfing the slopes of terraces and embankments, where the soil is good. There are several varieties, which differ chiefly in the breadth and length of the leaves, particularly those at the base of the stem. It is not so well adapted for the production of hay as it is for pasturage. It should enter into all mixtures designed for permanent pasture. The slender stems of this grass afford an excellent material for the manufacture of the finer kinds of Leghorn hats. Good and well-cleaned seed should have 95 per cent purity and 50 per cent germinating power. The power of germination, however, is usually much below this figure. When used for lawns, sow at the rate of 3 bushels per acre. According to Stebler and Schroeter, the seeds should never be covered, but only rolled after sowing, because they germinate better in the light than in darkness. This is the June-grass of the Northern States, Green-grass of Pennsylvania, and Smooth-stalked Meadow-grass of England.

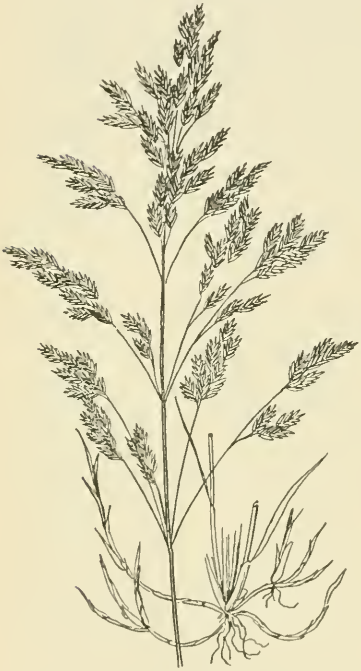


FIG. 76.—Kentucky Blue-grass (*Poa pratensis*).

No. 208. Poa subaristata Vasey. Vasey's Spear-grass.

A perennial, from central Montana, where it is common on dry hills and mountain slopes, forming a large percentage of the grass and supplying good pasturage. It is an excellent species for cultivation in Northern pastures.

No. 209. Poa trivialis Linn. Rough-stalked Meadow-grass.

An erect perennial, 1 to 3 feet high, with an open, spreading panicle, closely related to Kentucky Blue-grass, from which it differs in having no conspicuous rootstock and the stem distinctly rough below the panicle. It has been cultivated for many years in England, and is now highly esteemed as an ingredient in mixtures for permanent pastures. It succeeds best where the climate and soil are rather moist and cool, but is not adapted to sandy soil. In northern Italy this grass is known as the "queen of forage plants," but elsewhere, particularly in this country, it is not so highly esteemed, its principal use being to form bottom grass in permanent pastures. Seed of good quality should have 95 per cent purity and 50 per cent germination. When sown alone 1½ to 2 bushels of seed are required per acre.

No. 210. Poa wheeleri Vasey. Wheeler's Blue-grass.

A perennial native pasture grass that grows on the high plains and on the mountain slopes, below timber line, from Colorado northward. It is one of the best grazing grasses of the Rocky Mountains and promises to do well in cultivation.

No. 211. Pollinia fulva Benth. Sugar-grass.

A slender or rather stout perennial, 1 to 1 feet high, with narrow leaves and two to three terminal spikes, which are clothed with brown, silky hairs. It is a native of Australia, found throughout all the colonies of that country, growing chiefly on the richest soils and on deep alluvial flats bordering rivers and creeks. It is productive, and much prized by cattlemen. The name "sugar-grass" is applied to this species on account of the sweetness of its stems and foliage. Mr. Fred Turner recommends it for cultivation on good land, especially in grazing districts, and he speaks of it as being a good grass to plant on the banks of rivers, creeks, and dams, as its strong, penetrating roots would help to bind the soil and prevent its being washed away by heavy rains or floods. This grass is classed as a variety of *Pollinia cummingii* Nees, by Hackel.

No. 212. Puccinellia maritima (Huds.) Parl. Sea Spear-grass.

A slender grass, 12 to 18 inches high, with creeping rhizomes. It occurs in the marshes along the seacoasts of New England and the Middle States, and forms a valuable element of the hay of tide-water marshes.

No. 213. Redfieldia flexuosa (Thurb.) Vasey. Redfield's-grass. (Fig. 77.)

A stout, native perennial, 18 inches to 4 feet high, with long, narrow leaves and diffusely spreading panicles, growing in the sandy districts of Nebraska, Colorado, and Kansas. It has deeply penetrating and widely spreading underground stems or rhizomes, making it a valuable species for binding drifting sands. It is a characteristic grass of the sand hills of central Nebraska, growing in the drifting sands and "blow-outs," and is a conspicuous and almost the only grass found on the sand dunes south of the Arkansas River, near Garden City, Kans.

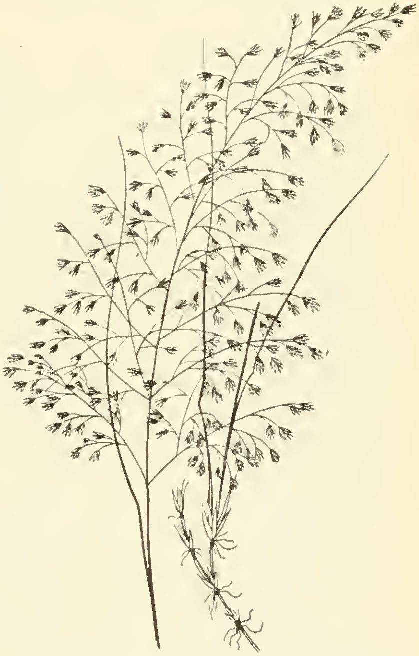


FIG. 77.—Redfield's-grass (*Redfieldia flexuosa*).

No. 214. Saccharum ciliare Anderss.

A tall, handsome grass of India, with smooth stems, 8 to 10 feet high, long leaves, and large, showy panicles of silky-hairy flowers. Used in the manufacture of matting, rope, and paper, and for thatching. The stems are made into sieves, screens, and baskets. The thicker portion of the stems is used for lining wells, and in making chairs and couches. The leaves are sometimes used for fodder, and when young the grass is grazed by cattle.

No. 215. Saccharum officinarum L. Sugar Cane.

A stout grass with many-jointed stems, 8 to 15 feet high, broad leaves, 3 to 4 feet long, and long (16 to 32 inches), pyramidal panicles. Native country unknown, but sparingly spontaneous in the South Sea Islands, where it blossoms freely. Cultivated in all tropical countries. Propagated chiefly by cuttings of the stems. There are many varieties, distinguished chiefly by the color and height of stem. The leaves are sometimes used for fodder, and, to a limited extent, also in paper making. The cane is cultivated, however, for its sweet juice, which yields from 12 to 20 per cent sugar. Under favorable circumstances an acre of ground will produce about 20 tons of cane. In this country the production of cane sugar on a commercial scale is practically limited to the States of Louisiana and Texas. The sugar production in Louisiana in 1889 was 292,124,050 pounds. The world's production of cane sugar was then about 3,000,000 tons, more than one-third of which was produced by the West Indies. Molasses is a product of sugar cane (the uncrystallizable sugar), and rum is made from molasses. Refuse cane, from which the juice has been expressed, yields a strong fiber, and in parts of India is used for torches, etc.

No. 216. Savastana odorata (Linn.) Scribn. Vanilla-grass. (Fig. 78.)

A rather slender, sweet-scented perennial, 1 to 2 feet high, with short culm leaves and brownish panicles. Moist meadows and mountains of the Northeastern States, extending westward to Oregon. This grass, remarkable for its fragrance, has long, creeping rhizomes, from which spring the flowering culms and numerous long-leafed sterile or flowerless shoots. These long leaves are woven into small mats and boxes by the Indians, and find a ready market because of the sweet odor, which they retain for a long time. This odor resembles that of sweet vernal grass, but is more powerful, especially when this grass is dry. In some European countries it is believed to have a tendency to induce sleep, and bunches of it are hung over beds for this purpose. It makes a good turf, but is of little value for forage. In the Northwest Vanilla-grass is generally called Sweet-grass.

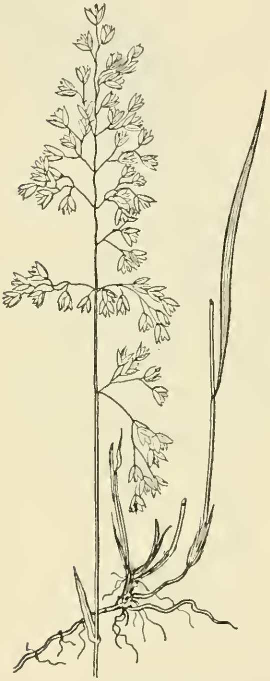


Fig. 78. — Vanilla-grass (*Savastana odorata*).

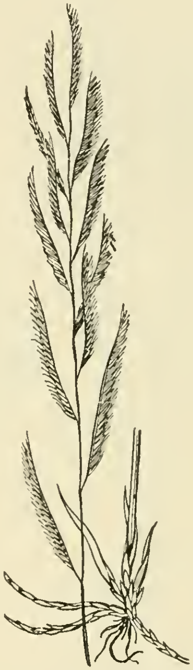


Fig. 79. — Cord-grass (*Spartina cynosuroides*).

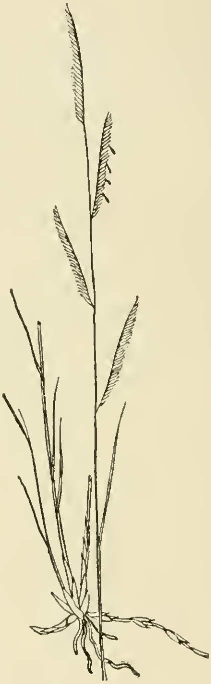


Fig. 80. — Fox-grass (*Spartina patens*).

No. 217. Secale cereale Linn. Rye.

An annual, 4 to 6 feet high, with flat leaves and a terminal, somewhat flattened, bearded spike 4 to 6 inches long. The rye crop of the United States in 1895 was 27,210,070 bushels, nearly half of which was produced in the States of

Pennsylvania, New York, and Wisconsin. Rye is more largely cultivated in central and northern Europe than in America; the grain is there very largely used for making bread. It is comparatively little used in this country for that purpose, being chiefly employed in the manufacture of malt and spirituous liquors. The straw, which is longer than that of other grains, and more uniform in size throughout, is employed in the making of a great variety of articles, such as paper, hats, bonnets, mats, slippers, toys, and fancy articles. Rye straw is little valued for fodder, but when green it is esteemed as a forage plant, and is sometimes sown for this purpose in the Southern States, cattle being allowed to graze on it during the fall and winter months. For winter grazing it should be sown upon well-prepared land early in August, when it will be ready to pasture or to cut green in the latter part of October, and may be grazed throughout the winter months.

No. 218. Spartina cynosuroides (Linn.) Willd. Cord-grass. (Fig. 79.)

Stout, with erect, simple stems 2 to 9 feet high, flat and long-pointed leaves, and numerous erect or spreading spikes 2 to 5 inches long. This is a native, common along our ocean and lake shores, borders of rivers, etc., ranging from Maine to the Carolinas, and westward to the Pacific. It makes a fair but rather coarse hay when cut early, and has been successfully employed in the manufacture of twine and paper. The strong, creeping, scaly rootstocks of this grass adapt it for binding loose sands and river banks, and in the West it is used for thatch.

No. 219. Spartina patens (Ait.) Muhl. Fox-grass. (Fig. 80.)

A rather slender species, 1 to 2 (rarely 3 to 4) feet high, with two to four slender, erect, or widely spreading spikes. This is common upon the salt marshes, and is one of the most valued species which go to form the salt hay that these marshes produce. It ranges from Maine southward to Florida and along the Gulf coast to Texas. It is useful for packing glassware, crockery, etc., and in the larger towns along the coast is much used for this purpose. Fox-grass and Black-grass (*Juncus gerardi*) are regarded as the best of the grasses of the salt marshes for the production of hay, and chemical analyses have proved the correctness of this opinion. Salt hay, composed chiefly of these grasses, at average market prices is decidedly cheaper than timothy hay.

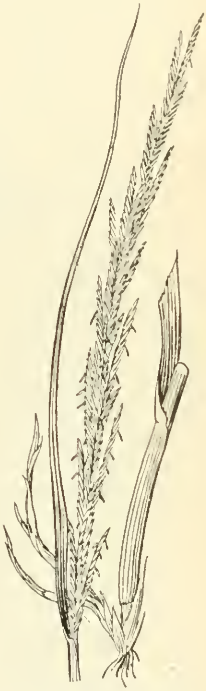


Fig. 81.—Creek-sedge (*Spartina stricta maritima*)

No. 220. Spartina stricta maritima (Walt.) Scribn. Creek-sedge. (Fig. 81.)

An erect and often stout salt marsh grass, with flat leaves, and few to many erect spikes. It varies a good deal in size, the larger form attaining a height of 5 to 8 feet. It grows along the ditches and creeks of the marshes, and is conspicuous by its size and long, shining leaves, which are of a deep green color. Smaller forms are found over the marshes away from the ditches, and these often are of a pale-green tint, with comparatively short and shining leaves. All the forms are somewhat succulent and have a rank odor, which is imparted to the milk and butter of cows feeding upon them. The species is of little value for fodder, but makes excellent thatch, and is used to some extent for litter and mulching. This is a characteristic grass of the salt marshes, and is found along both the Atlantic and Pacific coasts of our country and on the shores of Europe.

No. 221. Spinifex hirsutus Labill. Spiny Rolling-grass. (Fig. 82.)

A sand binder of the coasts of Australia, New Zealand, and Tasmania. It has stout, creeping stems, rooting at the joints, and sending up coarse, leafy tufts. The whole plant is clothed with soft hairs. The male and female flowers are borne on separate plants, the latter in globular heads, which fall off at maturity and are driven over the sands by the winds, dropping their seeds as they roll along, or are carried about by the waves and deposited on newly formed sand bars, there to continue the embanking process. It has no value for forage, but in New South Wales is regarded a most useful grass for fixing drift sands when encroaching upon valuable lands. It is readily propagated by cuttings or joints of the stems, is of comparatively quick growth, and is very persistent when once established. It would doubtless be of some value on our own Southern and Californian coasts as a sand binder.

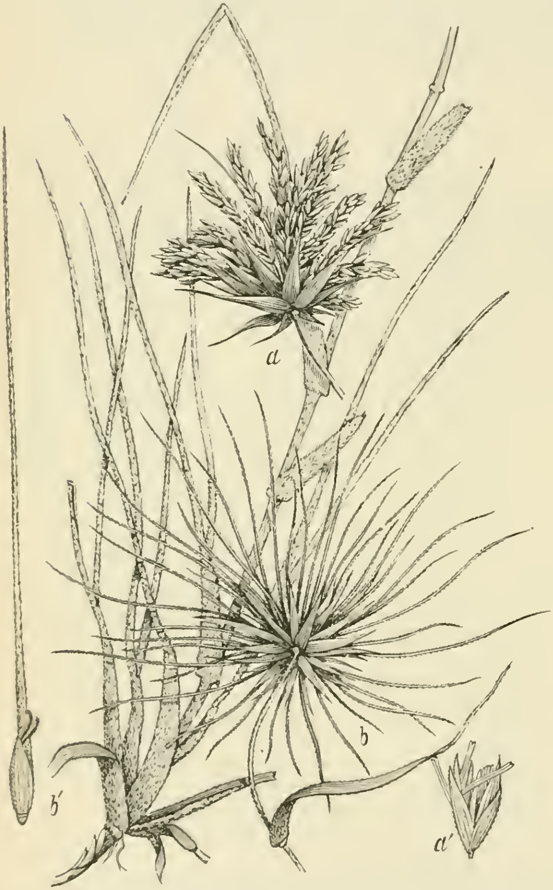


FIG. 82.—Spiny Rolling-grass (*Spinifex hirsutus*): *a*. male inflorescence; *b*, female inflorescence; *a′*, male spikelet; *b′*, female spikelet.

No. 222. Sporobolus airoides Torr. Alkali Saccaton. (Fig. 83.)

A stout rather coarse and rigid grass, growing on tussocks in sandy and more or less alkaline or saline soils along rivers and streams, ranging from Montana southward to Texas and westward to California. It has a widely spreading panicle, more open than saccaton, and the grass rarely exceeds 2 feet in height. In some places in Nevada, Utah, and New Mexico it occurs abundantly, and yields a coarse fodder, which is eaten by stock when more tender grasses are not available.

No. 223. Sporobolus asperifolius (Nees and Mey.) Thurb. Fine-top Salt-grass.

A low, somewhat creeping grass, 6 to 15 inches high, with numerous short, spreading, acute leaves, and an expanded capillary panicle 3 to 5 inches long. It grows on alkaline plains from Texas northwest to British Columbia, in similar situations as *Distichlis spicata*, and like that species often forms a dense, continuous turf. It grows well on strongly alkaline soil, and may prove valuable for propagation on such lands.

No. 224. Sporobolus cryptandrus (Torr.) A. Gray. Dropseed.

A strongly rooted perennial, 2 to 3 feet high, with usually narrow, rather densely flowered panicles, which are generally partially inclosed within the upper leaf-sheath. Common on the Western plains and in the Rocky Mountain region. It is a tender species, apparently well liked by stock, and where it occurs abundantly is very generally regarded as an important forage plant. In northern central Kansas it is spoken of as one of the best early grasses, and the same is said of it in Young County, Texas.

No. 225. Sporobolus indicus (Linn.) R. Br. Smut-grass. (Fig. 84.)

A tufted, wiry, erect perennial, 1 to 3 feet high, with narrow, densely flowered, spike-like panicles 4 to 12 inches long. This grass is widely distributed throughout the warmer temperate regions of the world, and has become quite common in many parts of the Southern States, growing in scattered tufts or patches about dwellings and in dry, open fields. As the season advances, the long, slender panicles often become overgrown by fungus, so that they appear as if attacked by smut; hence the common name "Smut-grass." By some it is looked upon as valuable for forage, but the stems soon become too tough and wiry to be readily eaten by stock, and in fields where this grass occurs it is usually avoided by cattle when other food can be had.

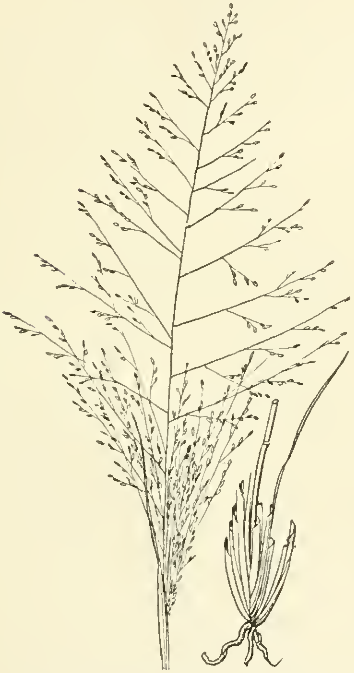


Fig. 83.—Alkali Saccaton (*Sporobolus airoides*).

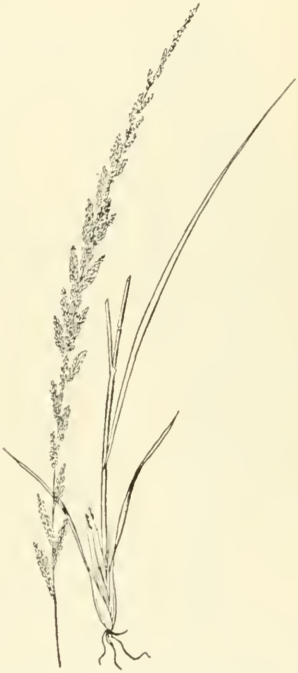


Fig. 84.—Smut-grass (*Sporobolus indicus*).

No. 226. Sporobolus junceus (Michx.) Kunth. Rush-grass.

Common in the dry, pine-barren regions of the Southeastern States. It grows to the height of 18 inches to 2 feet, and is of little or no agricultural value. This and *Aristida stricta* are known throughout the South as "Wire-grass."

No. 227. Sporobolus orientalis Kth. Usar-grass.

A wiry, creeping perennial, with rather short, rigid leaves and diffuse panicles. It is a native of India, growing upon saline soils, often constituting the entire vegetation of the extensive "usar" tracts of northern India. A valuable grass for alkaline or saline soils, yielding a liberal supply of fodder where other plants are unable to exist.

No. 228. Sporobolus wrightii Munro. Saccaton. (Fig. 85.)

A stout, erect perennial, 4 to 8 feet high, with long, narrow leaves and a slightly spreading panicle 12 to 36 inches long. It grows in great clumps, producing a large quantity of coarse, tough stems and leaves, which, however, in the regions where this grass is native—Arizona and New Mexico—yield a hay which is valued for horses and mules. As a hardy perennial for saline bottoms subject to flooding or incapable of cultivation, this species deserves notice. The Indians and Mexicans of Arizona and Lower California call all hay grasses "zacate," without any distinction between the species.

No. 229. Stenotaphrum dimidiatum (Linn.) Brongn. St. Augustine-grass. (Fig. 86.)

This grass has a wide distribution, being found in the tropical and warmer temperate regions of both the Old and New World. In New South Wales it is known as Buffalo-grass, and in Jamaica it is called Pimento-grass. It grows upon every variety of soil, from the apparently sterile sand dunes to heavy clays, but is rarely found far away from the coast. The flattened stems emit fibrous roots at every joint, where they also readily separate, each piece becoming a new center of growth. The leaves are flat or simply folded, blunt or obtuse at the apex, nearly one-fourth of an inch broad and 4 to 10 inches long. The flowering stems grow to the height of 6 inches to a foot or more. St. Augustine-grass grows along our ocean shores as far north as South Carolina, and is extensively used for lawns in Charleston, S. C., and cities in the South near the coast. It is useful for holding sloping embankments, especially those subject to wash. It is propagated by cuttings or sets, and quickly covers the most sandy yards with a dense, carpet like growth. In South America the creeping stems are employed in medicine as a diuretic. This is the Buffalo-grass of Australia, and other local names in this country are Mission-grass and Charleston Lawn-grass.

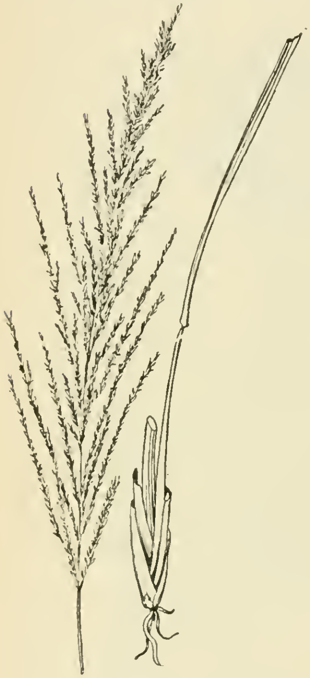


FIG. 85.—Saccaton (*Sporobolus wrightii*).

No. 230. Stipa comata Trin. & Rupr. Needle-and-Thread.

This is one of the bunch grasses common in the Rocky Mountain region, growing on the dry mesas and foothills. It is a rather stout, leafy perennial, 1 to 3 feet high, with a panicle usually partly inclosed in the upper leaf sheath; the slender awns of the spikelets are 4 to 6 inches long and flexuose. This grass has some value, affording forage of good quality in the regions where it grows abundantly. In Dakota, Wyoming, etc., it is valued as a hay grass.

No. 231. Stipa elegantissima Labill.

A native of Australia, with erect, branching stems 2 to 3 feet high, narrow leaves, and loose panicles 6 to 8 inches long. The axis and long, thread-like branches of the panicle are elegantly plumose with fine, spreading hairs, rendering it highly ornamental. Cultivated in gardens.

No. 232. Stipa leucotricha Trin. & Rupr. Bearded Mesquite.

An erect perennial 1 to 3 feet high, with very narrow leaves and a loose panicle with a few long-awned spikelets. One of the best native hay grasses of central and southern Texas.

No. 233. Stipa pennata Linn. Feather-grass.

A native of southern Europe, 1 to 2 feet high, growing in dry, open ground, and often cultivated in gardens as an ornamental, the very long, slender awns being clothed with spreading, silky hairs, presenting a very graceful plume-like appearance. A variety of this grass (*Stipa pennata neo-mexicana*) grows wild in the mountain regions of western Texas and Arizona. It is an elegant form of the species, growing in clumps 6 to 12 inches in diameter, and is deserving the attention of the florist.

No. 234. Stipa setigera Presl. Bear-grass.

A native of California, extending northward to Oregon and eastward through New Mexico and Arizona to Texas. It is common on the coast ranges and on the foothills of the Sierra Nevada, where it is regarded as one of the most valuable of the native bunch grasses.

No. 235. Stipa spartea Trin. Porcupine-grass.

Rather stout, 18 inches to 3 feet high, with long leaves and few-flowered panicles. The stout and twisted awns are 3 to 6 inches long, and at the base of the flowering glume is a long and very sharp-pointed callus. When mature, the awned flowering glumes soon fall off, leaving the large, pale, straw-colored, persistent empty glumes, which impart to the panicle a characteristic oat-like appearance. The awns, when dry, are bent and very strongly twisted, but when moistened they gradually untwist, a character which enables the seeds to bury themselves in the ground, this being possible on account of the very sharp callus at the base of the fruiting glume. The same character also renders the seeds of this grass dangerous to sheep, as they readily become attached to the wool, and may penetrate the flesh of the animal, causing serious injury. Aside from this danger of affecting the quality of the wool, and possibly the life of the sheep, this grass may be considered a good forage plant, as it makes a very good hay, although somewhat coarse. It is particularly common in the prairie regions of Iowa, Nebraska, South Dakota, and Minnesota, extending westward to the Rocky Mountains, where it frequently occurs upon the dry foothills and bench lands. This is the Buffalo-grass of the Saskatchewan region. In some localities it is known as Needle-grass, but that name is reserved for *Aristida fasciculata*. It is also known as "wild oats" in North Dakota.

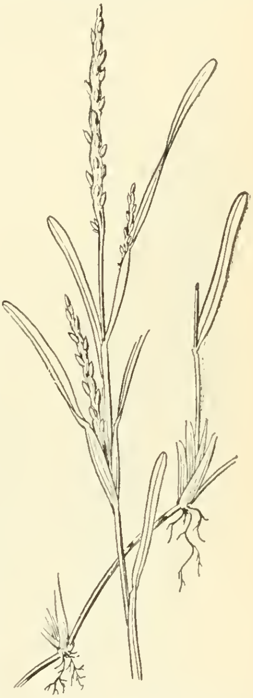


FIG. 86.—St. Augustine-grass (*Stenotaphrum dimidiatum*).

No. 236. Stipa tenacissima Linn. Esparto.

A native of the sandy regions of southwestern Europe and northern Africa. It is a tall perennial, with long, stiff, and very tough leaves, from which ropes, baskets, mats, hats, and other articles are woven. The leaves are employed largely in England and this country in the manufacture of paper, for which purpose this grass is superior to straw. It is one of the most important articles of export from Algeria, and from northern Africa and Spain more than 2,000 tons of Esparto are exported to Great Britain annually. "Ten tons of dry Esparto, worth from $18 to $25 per ton, can be obtained from an acre under favorable circumstances."

The grass will grow on almost any kind of soil, from that which is poor and sandy or gravelly to heavy calcareous and clayey soils. It thrives in the dry and hot climates of northern Africa, where many millions of acres are covered almost exclusively with it. This grass is extensively cultivated in the south of France, and possibly its introduction into some of our Southwestern districts may render profitable, regions now practically worthless. It may be propagated by seeds or by divisions of the root. The latter is the more common method. This and *Lygeum spartum* constitute the Esparto of commerce.

No. 237. Stipa vaseyi Scribn. Sleepy-grass.

A stout bunch-grass 3 to 5 feet high, which grows in the Rocky Mountains at an altitude of from 5,000 to 6,000 feet. This grass, although producing a large bulk of stems and leaves, is regarded with suspicion by stockmen. It is said that when this grass is eaten in a fresh state by horses it has a narcotic or poisonous effect, causing the animals to become crazed or "locoed," its action thus resembling that of the deadly loco weed (*Astragalus mollissimus*). Hay made from this grass does not apparently possess any poisonous qualities.

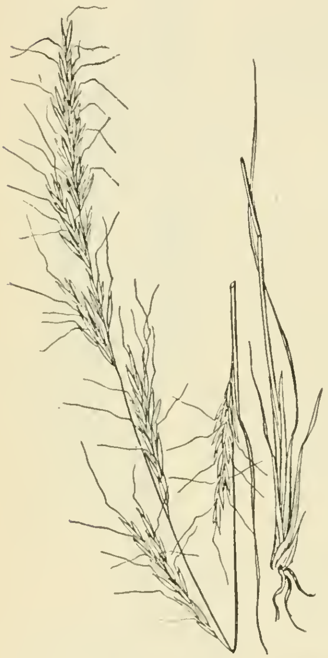


Fig. 87.—Feather Bunch-grass (*Stipa viridula*).

No. 238. Stipa viridula Trin. Feather Bunch-grass. (Fig. 87.)

A rather slender grass, 1 to 3 feet high, growing in the Rocky Mountain region and on the foothills and mesas, from British Columbia southward to Mexico and westward to the coast On good land, under irrigation, this grass attains the height of 3 feet or more, and is by far the most valuable of the Stipas for hay. The leafy culms are terminated by a narrow, many-flowered panicle of comparatively small and rather short-awned spikelets. The seed may be easily gathered. The callus at the base of the fruiting glume is short and barely pointed and not produced into a long, very sharp, spur-like extension, as in Porcupine-grass.

No. 239. Thuarea sarmentosa Pers.

A low, extensively creeping grass, rooting at the joints, with ascending flowering branches, short leaves, and slender spikes about an inch long. A native of Ceylon, northern Australia, etc., growing on the sands of the coast. It is a tender grass, and may be useful in binding coast sands in tropical countries or in the formation of lawns.

No. 240. Trichloris blanchardiana Scribn.

A perennial, 1½ to 3 feet high, with flat leaves, and six to eighteen slender, bearded spikes, which are 2 to 5 inches long, digitate or fasciculate at the apex of the culm. It has long been known to florists under the name of *Chloropsis blanchardiana*, and is esteemed as an ornamental grass, its attractive appearance making it worthy of attention. It grows in Arizona and Mexico, extending into South America.

No. 241. Tricholæna rosea Nees.

A South African annual (?), with diffusely branching stems 2 to 4 feet high. The spikelets are in loose panicles, and clothed with reddish, silky hairs. It presents a pleasing appearance when in flower, and the panicles are valued for dry bouquets. It has recently received some attention by agriculturists on account of its very vigorous rapid growth and productiveness. Experiments made in this country and elsewhere indicate that it possesses much value as a meadow or hay grass in mild climates. Three hundred stems have been counted on a single plant. These stems take root wherever they touch the ground, and an acre has been calculated to yield 30 tons of green fodder in the rich valleys of the Macleay River, New South Wales. It is easily propagated by seed.

No. 242. Triodia exigua Kirk.

A little alpine grass, endemic in New Zealand. It forms even plots of turf, often many square yards in extent; the leaves are firm, short, and shining; the compact growth of the turf or sward prevents the encroachment of other grasses or weeds. It is particularly to be recommended for croquet lawns, never requiring mowing (Kirk). In the mountain regions of the West are several of these small turf-forming grasses, which would, if cultivated, make excellent carpet-like lawns in the region of the Northern and Middle States.

No. 243. Triodia seslerioides (Michx.) Benth. Fall Redtop.

A stout, erect, native perennial, 3 to 5 feet high, with long, flat leaves and an ample, spreading, usually purple panicle 6 to 12 inches long, growing in dry or sandy fields from southern New York southward and westward to Missouri, blooming in August and September. It is a striking grass, and often covers considerable areas, but is apparently not liked by stock, and is not recognized as possessing any agricultural value.

No. 244. Tripsacum dactyloides Linn. Gama-grass. (Fig. 88.)

A tall, coarse perennial, 3 to 8 feet high, growing in large tufts, and producing a great mass of broad leaves, which when young and succulent are eaten with avidity by all kinds of stock. When abundant it affords a large amount of natural forage, and is valuable to this extent. It has very strong, creeping rootstocks, and the quantity of forage produced is large and of excellent quality. The grass may be deserving of cultivation for forage under certain conditions, and it makes an interesting and attractive plant for lawn decoration or the garden. A rich and rather moist soil is best suited to it.

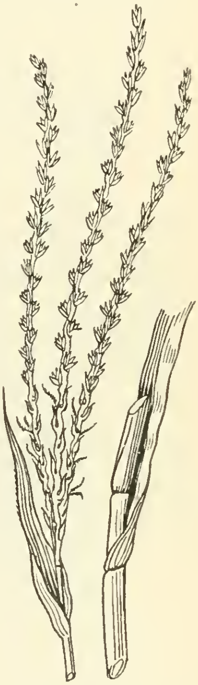


Fig. 88.—Gama-grass (*Tripsacum dactyloides*).

No. 245. Trisetum pratense Pers. Yellow Oat-grass.

A rather slender, loosely tufted perennial, growing to the height of 2 feet. It is a native of Europe, northern Africa, and western Asia. It occurs along roadsides, in open fields, and on grassy mountain slopes, where its presence is said to indicate land of good quality. In Europe, Yellow Oat-grass is classed with the best fodder plants and is highly valued for temporary, but more particularly for permanent pastures. It can be grown on almost every variety of soil, is fairly productive, and is readily eaten by stock. This grass has a record of yielding on clayey loam soils 8,167 pounds green grass, 2,858 of hay, and 4,083 of aftermath per acre. In this country it has received little attention. It is quoted in New York seed catalogues, the price ranging from $70 to $115 per 100 pounds. Sown only in mixtures.

No. 246. Triticum æstivum Linn. Wheat.

Wheat in its many varieties is one of the most important of the true grasses. It is one of the oldest of the cultivated cereals, the grains having been found in very ancient Egyptian monuments, dating back to 2,500 or 3,000 B. C. The numerous varieties are distinguished by the firmness of the axis of the spike (continuous), or its brittleness (articulated); by the presence or absence of awns or beard; by the color of the chaff, and color and size of the grain. *Triticum æstivum speltum*, of which there are a number of subvarieties, is one of the oldest grains, and was everywhere cultivated throughout the Roman Empire, forming the chief grain of Egypt and Greece. It is still grown to some extent in parts of Europe, notably in northern Spain and southern Germany. In 1895 the wheat crop of the United States was placed at 467,102,947 bushels, while the wheat crop of the world is estimated at 2,400,000,000 bushels. For a discussion of the classification of the varieties of wheat, see Hackel's True Grasses (English translation), and the Fourth Annual Report of the New York Agricultural Experiment Station, 1885.

No. 247. Triticum polonicum Linn. Wild-goose Wheat.

A very striking species or variety of wheat, with large, compressed, and usually bluish-green spikes or heads. The native country of this *Triticum* is not known, but it probably originated in Spain, where it is now cultivated to a considerable extent. It is also cultivated more or less in Italy and Abyssinia. The long and slender fruit resembles rye, but is on the whole larger. It has sometimes been advertised by seed dealers and sold to farmers under the name of Giant Rye. It is inferior to many other varieties, for, although the heads present a fine appearance, the production of kernels is small; consequently the yield of grain is light.

No. 248. Uniola latifolia Michx. Broad-leafed Spike-grass. (Fig. 89.)

Erect, with rather stout, leafy stems 2 to 4 feet high, and drooping panicles of large, flat spikelets. The leaves are broad and widely spreading, and these, together with the graceful, nodding, open panicles, render it pleasing in appearance and worthy of cultivation for ornament. It has very strong, creeping roots, and is found chiefly along streams and thicket borders from Pennsylvania southward and westward to Illinois. A grass of little or no agricultural value.

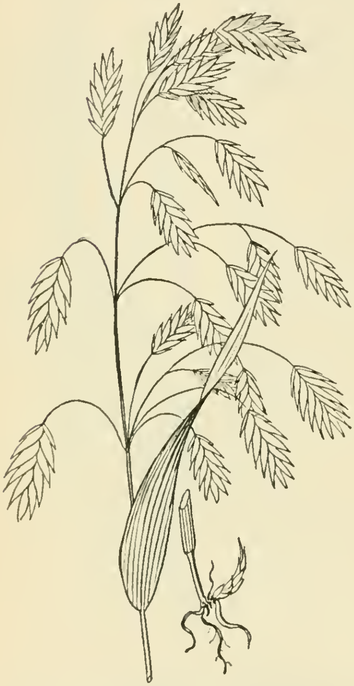


Fig. 89.—Broad-leafed Spike-grass (*Uniola latifolia*).

No. 249. Uniola paniculata Linn. Seaside Oats.

A native, with stout, erect stems 3 to 5 feet high, long, rigid leaves, and showy nodding panicles of broad, pale straw-colored spikelets. The panicles are gathered for dry bouquets, and are often seen in our markets, along with the plumes of Pampas-grass. It grows in the drifting sands along the seashore, just above high tide, from Virginia southward to Florida, and along the Gulf Coast westward to Texas. It is an excellent sand binder, its rootstocks being very strong and penetrating deeply into the soil, much like those of Beach or Marram grass, of which it is a southern analogue. The leaves are sometimes cropped by cattle, but the grass is too tough and dry to be of any importance as a forage plant. *Uniola condensata* of similar habit of growth, but with more densely flowered panicles, is found in the sands along the coast of Lower California.

No. 250. Zea mays Linn. Indian Corn or Maize.

One of the most valued of the cultivated cereals. The many varieties which have originated in cultivation have been variously classified. They differ much in size, in the form, size, color, and hardiness of the grain, and in the time required for ripening. Husk Maize, in which the kernels are separately enveloped in broad, herbaceous glumes, may approach the native form, which doubtless had its origin in tropical America. *Mais de coyote,* regarded by some as a distinct species, is said to grow wild in some parts of Mexico. The stems of this variety are branched above, and the numerous small ears are borne in the upper leaf axils all along the branches. The kernels are rounded and depressed, or conical with a rather acute apex pointing forward in two opposite rows, or irregularly arranged in four to six rows. Aside from its great value as a cereal, ordinary field corn is the best of the annual forage plants for soiling, and is also valued and used by many farmers for ensilage, being cut for this purpose when the kernels commence to glaze. Among the many uses of corn may be mentioned that of making cakes and corn bread, mush or hasty pudding, which is boiled corn meal, a very common dish in New England; mixed with rye and wheat flour the corn meal is used in making "brown bread"; green corn, boiled or roasted, is very largely eaten in its season, and canned corn is an important article of food; pickled green corn also is a favorite dish with many; hulled corn, or hominy, prepared by soaking the ripe grain in lye for a certain length of time and then removing the hulls or covering of the kernels, is a favorite dish in New England; popped corn, obtained by shaking the shelled corn of certain varieties in a suitable dish over live coals or a hot stove, is a luxury with children, and mixed with sugar or sirup is made into corn balls and various kinds of candy; corn and corn meal are largely fed to farm stock in this country, particularly to cattle and hogs; alcoholic liquors in immense quantities are distilled from the grain; corn husks (the leaves covering the ears) are used in making paper, in upholstery, and for filling mattresses. The total corn crop of the United States for the year 1895 was 2,151,138,580 bushels, valued at $544,985,534. The largest crop of any one State for that year was produced by Iowa, and amounted to 298,502,650 bushels.

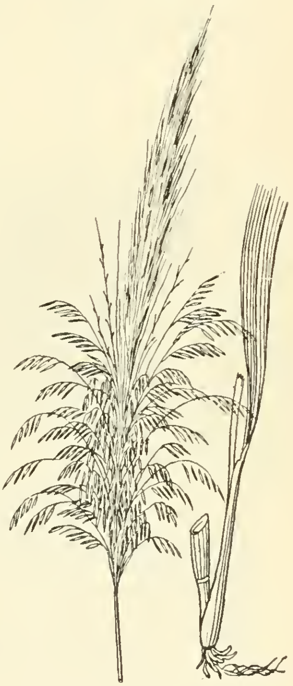


FIG. 90.—Wild Rice (*Zizania aquatica*).

No. 251. Zizania aquatica Linn. Wild Rice. (Fig. 90.)

A tall, erect annual, 3 to 10 feet high, growing in shallow water along rivers and lakes from Canada southward to Florida and westward to Texas. The grain is a favorite food of the reed bird, and the grass is cultivated to some extent by sportsmen with a view to attracting these and aquatic fowl. It grows very rapidly in 1 to 8 feet of water, and matures its seeds in August or early in September. It succeeds best when sown in the fall broadcast in 2 or 3 feet of water having a muddy bottom, but it can be sown in the spring in water from 6 inches to 5 feet deep. Before sowing soak the seeds in water twenty-four hours. Current retail price of the seeds is 25 cents per pound. This grass is abundant in the tide waters of the rivers of the Middle States, notably in the Delaware below Philadelphia, where it is always designated as "the reeds." The stems are used by coopers for making the joints of barrels intended to hold whisky or petroleum perfectly tight. This grass is the *Manorrin* of the Chippewa Indians, who gather the grain for food.

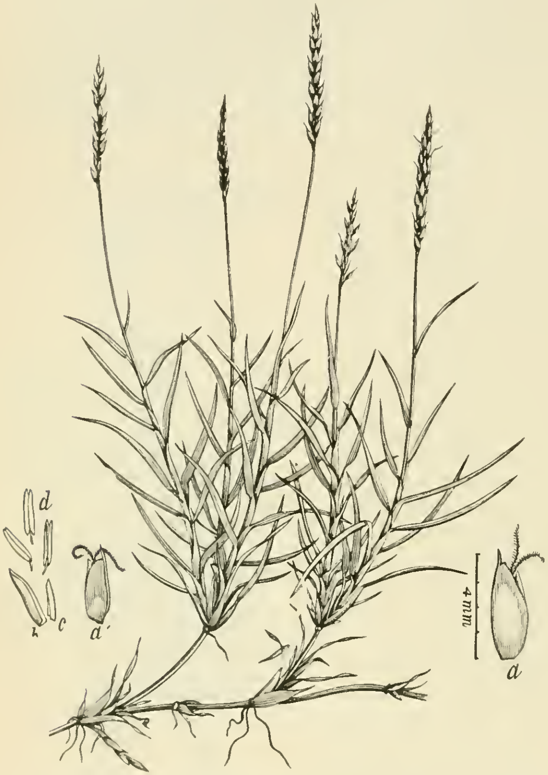


Fig. 91.—Japanese Lawn-grass (*Zoysia pungens*): *a* to *d* details of the spikelet.

No. 252. Zoysia pungens Willd. Japanese Lawn-grass. (Fig. 91.)

A creeping maritime grass growing on the sandy shores of tropical and eastern Asia, Australia, and New Zealand. In Australia it is considered an excellent sand-binder, and, while valuable for this purpose, it is at the same time an excellent forage plant. Under favorable circumstances it forms a compact turf and affords a large amount of choice pasturage. Constant cropping appears to improve it and increase the density of the turf. In the foreign settlements of China and Japan it is prized as a lawn grass, especially for tennis courts. It is finer-leafed than St. Augustine-grass, and may prove superior to that for lawns in the Southern and Gulf States. The habit of growth of Japanese lawn-grass is very similar to that of Bermuda, but the creeping stems are rather stouter and more rigid and the upright branches or tufts of flowering stems are never so tall, rarely exceeding 6 inches. It may be propagated by root cuttings or by seed. Importations of both roots and seeds from Korea have been successfully grown here, and the grass has proved hardy as far north as Connecticut. The leaves turn brown in the autumn, as do those of Bermuda.

GRASSES FOR SPECIAL SOILS OR USES.

The following lists include the best known and most valuable of the economic grasses. Descriptions of the species enumerated will be found in the body of the work. Seeds or roots of nearly all can be obtained from seedsmen.

HAY GRASSES.

Agropyron tenerum, Agrostis alba, A. vulgaris, Alopecurus pratensis. Andropogon halepensis, A. provincialis, Arrhenatherum elatius, Astrebla pectinata, Avena sativa, Bouteloua curtipendula, Brachypodium japonicum, Bromus inermis, Chætochloa italica, Cynodon dactylon, Cynosurus cristatus, Dactylis glomerata, Eragrostis abyssinica, Euchlæna luxurians, Festuca elatior, Hordeum sativum, Lolium italicum, L. perenne, Oryza sativa, Panicum crus-galli, P. maximum, P. miliaceum, P. molle, P. sanguinale, P. texanum, Pennisetum spicatum, Phalaris arundinacea, Phleum pratense, Poa pratensis, Saccharum officinarum, Tricholæna rosea, Trisetum pratense, Triticum æstivum, Zea mays.

PASTURE GRASSES.

Agropyron divergens, Agrostis alba, A. stolonifera, A. vulgaris, Andropogon nutans, A. provincialis, A. scoparius, Aristida fasciculata, Astrebla pectinata, Bouteloua curtipendula, B. eriopoda, B. oligostachya, Brachypodium japonicum, Bromus unioloides, B. inermis, Bulbilis dactyloides, Chloris verticillata, Cynodon dactylon, Dactylis glomerata, Eriochloa punctata, Eriocoma cuspidata, Festuca duriuscula, F. elatior, F. ovina, F. rubra, Hilaria cenchroides, Lolium perenne, Panicum ciliatissimum, Paspalum compressum, P. distichum, Poa arachnifera, P. compressa, P. pratensis, P. trivialis, Secale cereale, Stenotaphrum dimidiatum.

LAWN GRASSES.

Agrostis coarctata, A. stolonifera, A. canina, Bulbilis dactyloides, Cynodon dactylon, Festuca heterophylla, F. rubra, Fourniera mexicana, Opizia stolonifera, Paspalum compressum, Poa nemoralis, P. pratensis, P. trivialis, Stenotaphrum dimidiatum. Zoysia pungens. (See paper on "Lawns and Lawn Making" in Yearbook of the Department for 1897.)

GRASSES FOR WET LANDS.

Agrostis alba, A. coarctata, A. vulgaris, A. stolonifera, Arundinaria macrosperma, A. tecta, Calamagrostis canadensis, Chætochloa magna, Distichlis spicata, Festuca rubra, Holcus lanatus, Lolium italicum, Oryza sativa, Panicularia americana, P. fluitans, P. nervata, Panicum crus-galli, P. molle, Paspalum compressum, P. distichum, Phalaris arundinacea, Poa flava, P. pratensis, Stenotaphrum dimidiatum, Zizania aquatica.

GRASSES FOR EMBANKMENTS.

Agropyron repens, Andropogon halepensis, A. squarrosus, Arundinaria macrosperma, Bromus inermis, Calamovilfa longifolia, Cynodon dactylon, Distichlis spicata, Festuca rubra, Imperata arundinacea, Panicum digitarioides, P. obtusum, P. repens, Paspalum compressum, P. distichum, Phalaris arundinacea, Phragmites vulgaris, Spartina cynosuroides, Stenotaphrum dimidiatum, Zoysia pungens.

GRASSES FOR HOLDING SHIFTING SANDS.

Agrostis coarctata, Ammophila arenaria, Andropogon hallii, Calamovilfa longifolia, Cynodon dactylon, Elymus arenarius, E. mollis, Eragrostis obtusiflora, Imperata arundinacea, Muhlenbergia pungens, Panicum amarum, P. repens, Redfieldia flexuosa, Spartina patens, Spinifex hirsutus. Stenotaphrum dimidiatum, Thuarea sarmentosa, Uniola paniculata, Poa macrantha, Zoysia pungens. (See paper on "Grasses as Sand and Soil Binders" in the Year-book of the Department for 1894.)

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[The English names printed in *italics* are the ones in most common use; these only appear in the text. The references are to the numbers, not to pages.]

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BULLETIN No. 14. (Revised.) Agros. 34

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

ECONOMIC GRASSES.

BY

F. LAMSON-SCRIBNER,

AGROSTOLOGIST.

1862 1889

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., February 26, 1900.

Sir: Owing to a continued demand for copies of Bulletin No. 14 of this Division, entitled "Economic Grasses," after the first edition was exhausted, I have revised the matter contained therein and have the honor to request the printing of a new edition of same. This bulletin embraces brief descriptions of the more important economic grasses of this country, or those which have been introduced because possessing some merit, and it is believed affords a ready answer to the usual inquiries respecting a large number of our grasses. Much of the matter here presented is taken from Bulletin No. 3 of this Division, but owing to the fact that that bulletin exceeded 100 pages the edition published was limited to 1,000 copies, and consequently was very quickly exhausted.

Respectfully,

F. Lamson-Scribner,
Agrostologist.

Hon. James Wilson,
Secretary of Agriculture.

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ECONOMIC GRASSES.

DESCRIPTIONS.

No. 1. Agropyron caninum (L.) R. & S. Bearded Wheat-grass.

A fibrous-rooted, rather slender, upright perennial, 2 to 3 feet high, with bearded, nodding heads or spikes resembling slender heads of wheat. This grass is more or less frequent in the northern parts of the United States, ranging from Maine westward to the Dakotas. Bearded Wheat-grass is closely related to the more common and better known Couch-grass (*A. repens*), but differs markedly from that species in having no creeping rootstocks, and in the longer beards or awns to the spikelets. No attempts have been made to introduce this grass into general cultivation, but its habit of growth and other characters indicate that it may possess considerable agricultural value. It is readily propagated by seeds, which may be easily gathered.

No. 2. Agropyron divergens Nees. Wire Bunch-grass.

A slender, usually densely tufted perennial, 1 to 2 feet high or more, with very narrow, spreading leaves, and bearded or beardless spikes. The beards or awns, when present, are widely spreading or divergent. This grass is common in the Rocky Mountain and Pacific Slope regions, extending westward to the coast. On rich lands it often grows to the height of 3 feet, but upon the dry bench lands it rarely exceeds a foot or 18 inches in height. On dry lands the stems become wiry with age, and are avoided by stock; but the grass is considered valuable by the ranchmen for winter grazing. Samples of this grass received from some points in the West, particularly from Washington, indicate that it possesses much agricultural value when grown upon good soil, and as it will thrive in the semiarid regions of the Northwest, its cultivation may prove desirable. Propagated readily by seed, which can be easily gathered.

No. 3. Agropyron pseudorepens Scribn. & Smith. Western Couch-grass.

A perennial, with creeping rootstocks, abundant in the northern prairie States, producing tall and leafy stems, which resemble those of Couch-grass, but are less wiry. This is less plentiful in the semiarid belt than the Western Wheat-grass or Colorado Blue-stem, but is better adapted for cultivation as a hay grass because of its softer stems and leaves. It is one of the most promising native species.

No. 4. Agropyron repens (L.) Beauv. Couch-grass. (Fig. 1.)

A grass abundant everywhere in the Eastern and Middle States, growing in the open fields, and in many places it has become one of the worst of weeds. Often the chief labor in managing hoed crops consists in subduing this pest. When once established, it is hardly less difficult to eradicate than the well-known Johnson-grass of the Southern States. It is, however, a valuable hay grass, and for two or three years the yield is large, but, like the Western Blue-stem, it "binds itself out," and the sod requires breaking in order to restore the yield. It is an excellent grass for binding railroad and other embankments subject to wash, and can be recommended for this purpose. The roots are well known in medicine under the name of *Radix graminis*. The simple infusion is used as a diuretic. Propagated by "root cuttings" or by seed.

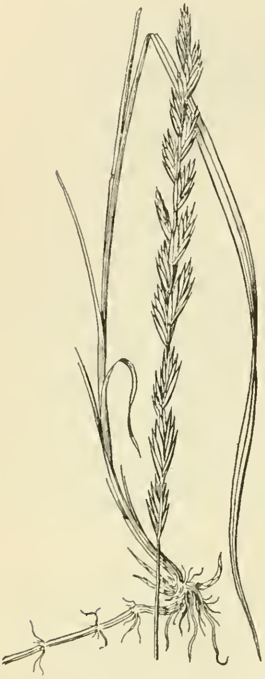


FIG. 1—Couch-grass (*Agropyron repens*).

No. 5. Agropyron spicatum (Pursh) Scribn. & Smith. Western Wheat-grass.

A grass closely resembling the Couch-grass of the Eastern States, and by some regarded as only a variety of it. It has the same strong and extensively creeping rootstocks, and the foliage and spikes are very similar, but the whole plant usually has a bluish color, whence the common name "Blue-stem," most frequently applied to it in the West. It grows naturally on the dry bench lands and river bottoms; and, although the yield per acre is not large, the quality of the hay is unsurpassed by any other species of the region where it grows. In Montana and the neighboring States it furnishes a considerable amount of native hay, and is there regarded as one of the most important of the native forage plants. After three or four successive annual cuttings, the yield diminishes very much, but the grass is "brought up" by letting it stand a year or two, or by dragging over the sod a sharp-toothed harrow, thus breaking the roots into small pieces, every fragment of which makes a new plant. This grass is quite distinct from the "Blue-stem" grasses of Nebraska, which are species of *Andropogon* (*A. provincialis*). There are a number of other species of *Agropyron* or wheat-grasses in the Rocky Mountains, some of which are evidently excellent hay grasses and well deserve the attention of the agriculturist.

No. 6. Agropyron tenerum Vasey. Slender Wheat-grass.

A perennial bunch grass growing in the northern prairie region from Nebraska to Montana and Manitoba. Seed of this grass is now on the market, its sterling qualities for hay having long been recognized by Northwestern farmers. It produces an abundance of soft, leafy stems and root leaves, and ripens a large amount of seed that is easily gathered—two of the chief requisites of a good hay grass. This grass is well adapted for cultivation, and the area devoted to it is deservedly increasing each year.

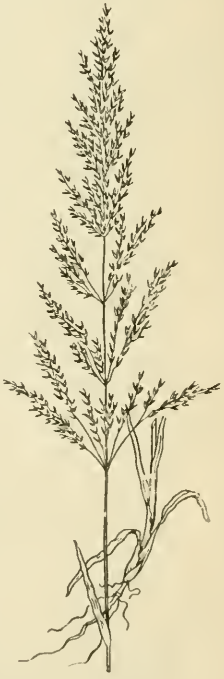


FIG. 2.—Redtop (*Agrostis alba*).

No. 7. Agrostis alba Linn. Redtop or Herd's-grass.

Under the botanical name of *Agrostis alba* are included a number of varieties, some of which have received distinct Latin names; as, for example, *Agrostis vulgaris* and *Agrostis stolonifera*, and many English or local names; that most generally applied in the Middle and Eastern States being Herd's-grass, and in the South and West, Redtop. The great variability of this grass has led to much diversity of opinion in regard to its value. The taller forms are largely cultivated for hay, being usually mixed with timothy and clover. This grass requires considerable moisture in the soil, and is one of the best for permanent pastures in the New England and Middle States. It makes a very resistant and leafy turf, which well withstands the trampling of stock. It grows well, also, as far south as Tennessee. Among the forms of low growth are two varieties which are unsurpassed, either in fineness or richness of color, for making lawns.

No. 8. Agrostis asperifolia Trin. Rough-leafed Bent.

This grass is common in the Rocky Mountain regions and on the Pacific Slope, growing chiefly in the mountain parks and along water courses. Its slender leafy culms are 2 to 3 feet high, and the narrow, pale-green, and densely flowered panicles 4 to 6 inches long. Judging from the appearance of this grass, it is likely to prove, under cultivation, superior to the Herd's-grass or Redtop of the East, at least for hay.

No. 9. Agrostis canina Linn. Rhode Island Bent.

This species of bent has been introduced into this country from Europe, and is cultivated to some extent in the Eastern States. It resembles Herd's-grass (Redtop) somewhat, but has shorter and narrower leaves. It makes a close sod, and is considered valuable for permanent meadows and pastures. It is one of the best grasses for lawns, and for this purpose should be sown at the rate of 3 to 4 bushels per acre. Retail price of seed quoted in New York catalogues, $2.75 per bushel.

No. 10. Agrostis coarctata (Reichb.) Ehrh. Sea-coast Bent.

A creeping perennial with slender culms, the upright branches 1 foot high, short and narrow flat leaves, and densely flowered panicles 2 to 4 inches long. It grows in damp soils and sands along the sea coast from Newfoundland to New Jersey, often occurring where constantly drenched by the flying salt spray. It is a fine-leafed, excellent turf-forming species, valuable for lawns. A similar if not identical species is common in western Oregon and Washington.

No. 11. Agrostis exarata Trin. Northern Redtop.

The grass upon which this species was founded is a native of Alaska, but a number of forms which occur in the Rocky Mountain regions and on the Pacific Slope have been referred to it. Some of these have been characterized as distinct species, and there are several among them which, from their tall, leafy habit and vigorous growth, indicate the possession of considerable agricultural value, although none of them have as yet been introduced into cultivation. They are deserving of the attention of the agriculturist, and their culture is recommended, particularly on the Pacific Slope. They would doubtless thrive in the Eastern and Middle States, and possibly supplant, by their greater luxuriance and better qualities, some of the species now cultivated.

No. 12. Agrostis scabra Willd. Rough Bent.

A slender, erect, tufted annual, with numerous very narrow basal leaves, and delicate, widely spreading capillary panicles, which at maturity break away from the culm, and are blown about by the wind, hence one of the common names, "fly-away-grass." Before the panicle has fully expanded, this grass is sometimes gathered and sold under the name of "silk-grass" for dry bouquets. It is widely distributed throughout the United States, but is of little or no agricultural value. In irrigated meadows of the Northwest this species, or a form of it, is occasionally sufficiently abundant to furnish a large amount of hay which is regarded of good quality.

No. 13. Agrostis stolonifera Linn. Creeping Bent.

By some regarded as only a variety of *Agrostis alba*, with long, prostrate or creeping stems, well adapted for sandy pastures near the coast, and useful, perhaps, for binding shifting sands or river banks subject to wash or overflow. It makes a good pasture grass for low lands, especially for those which are somewhat sandy, and produces a fine and enduring turf for lawns, for which is is especially well adapted. It is not a productive hay grass, although it has a record of yielding on rich, peaty soil 7,742 pounds of hay and 2,722 pounds of green aftermath per acre. If sown alone, sow at the rate of 2 bushels per acre, or for lawns 3 bushels. Current retail price in New York, $3.50 per bushel.

No. 14. Agrostis vulgaris With. Herd's-grass; Redtop.

This is little more than a variety of *Agrostis alba*, already noted. It is quoted in the seed catalogues as a distinct species, and is recommended for mixtures designed for permanent pastures or meadows. It succeeds as far south as Tennessee, and is often sown with timothy and red clover. Retail price of seed, New York market, $1 to $1.50 per bushel.

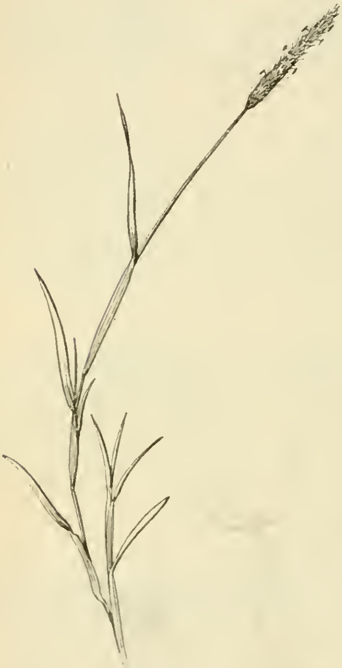


FIG. 3.—Water Foxtail (*Alopecurus geniculatus*).

No. 15. Alopecurus geniculatus Linn. Water Foxtail. (Fig. 3.)

A low, usually procumbent grass, with slender stems 8 to 18 inches long, often rooting at the lower joints. It usually grows in wet places, and is very widely distributed throughout the north temperate zone. It has cylindrical heads or panicles, resembling those of Meadow Foxtail, but much smaller. This grass enters into the natural herbage of low, wet meadows and pastures, and in such places affords excellent grazing, being tender and nutritious. *Alopecurus fulvus* is simply a variety of this, with short-awned flowering glumes. Under favorable circumstances this grass makes a good turf and a pleasing lawn of a deep rich green color, remaining green throughout the severe winter weather of the Middle States.

No. 16. Alopecurus occidentalis Scribn. Mountain Foxtail.

A grass of the mountain meadows of the Rocky Mountains, growing in rich soil along streams and in the open parks. It has slender, erect stems 2 to 3 feet high, with short, oblong heads, thicker and shorter than those of common Meadow Foxtail. This grass is occasionally found covering extensive areas to the exclusion of other species. It yields a large bulk of fine, long, bright-colored hay, which is highly valued where it can be obtained. For the more elevated meadows of the Rocky Mountain region, and doubtless also for the New England and North Middle States, this grass would form an excellent addition to the cultivated species, and its introduction is recommended.

No. 17. Alopecurus pratensis Linn. Meadow Foxtail. (Fig. 4.)

This well-known European grass has been introduced into this country and cultivated to some extent in the New England and Middle States. It is a valuable grass for moist meadows and pastures, particularly the latter, on account of its

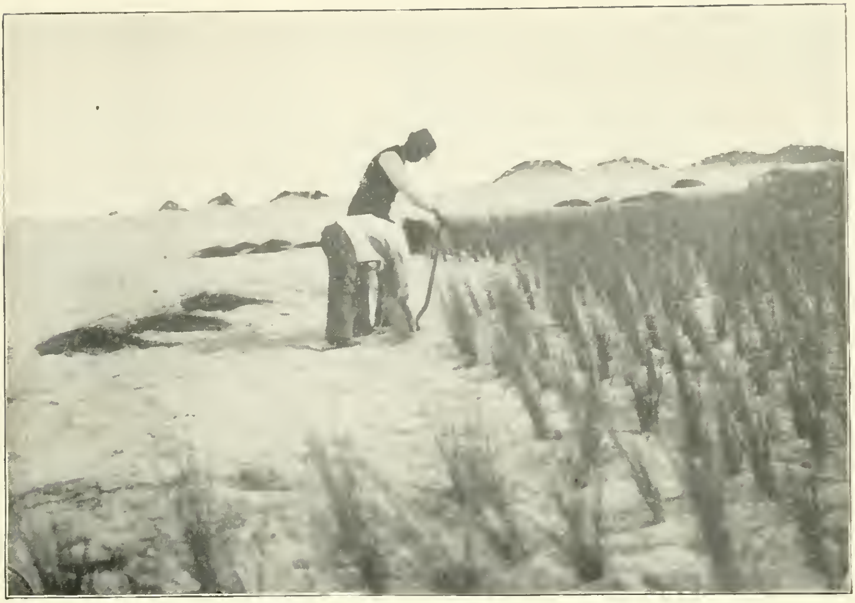


FIG. 1.—PLANTING BEACH GRASS IN SAND NEAR PROVINCETOWN, MASS.

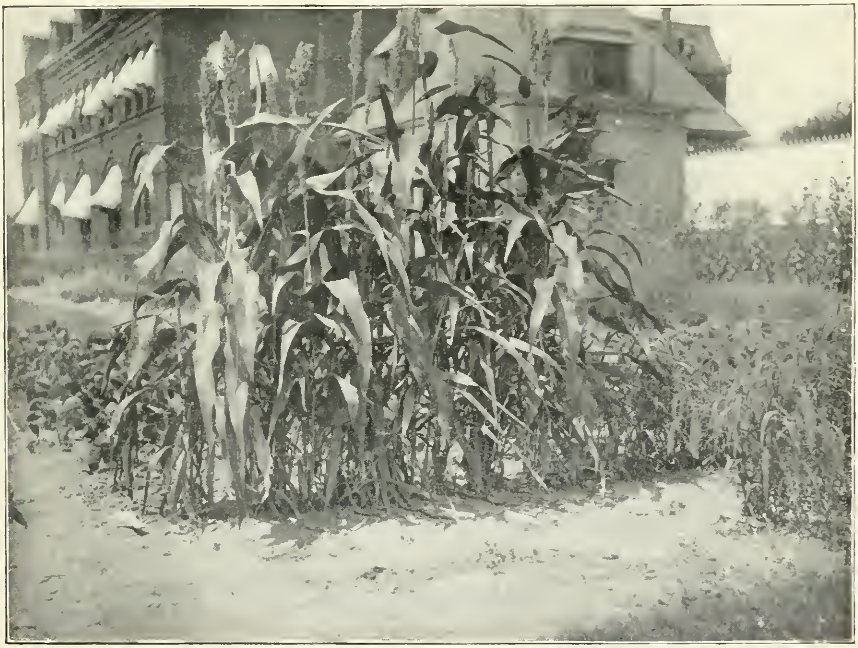


FIG. 2.—KAFIR CORN IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

early growth, being one of the earliest of the cultivated grasses. It is very hardy, and on good soil yields a large amount of excellent forage. In Europe it is regarded as one of the best perennial pasture grasses. It should enter into all mixtures for permanent pastures, because it is very lasting, highly nutritious, and earlier than most other species. This grass has a record of producing 20,418 pounds per acre of green grass, 6,125 pounds of hay, and 8,167 pounds of aftermath. It is never sown by itself, but is always mixed with other grasses and forage plants, because it gives a full yield only in the second or third year. Average number of seeds in a pound, 907,000. Price of seed quoted in New York catalogues, $2.30 per bushel, or $32 per 100 pounds.

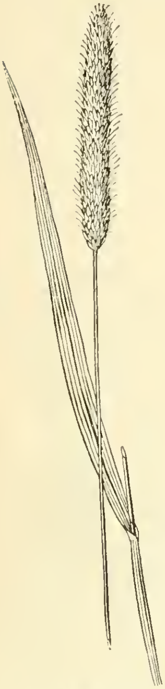


FIG. 4.—Meadow Foxtail (*Alopecurus pratensis*).

No. 18. Ammophila arenaria (Linn.) Link. Beach-grass. (Fig. 5.)

This grass grows more or less abundantly along the sandy coasts of the Atlantic and the shores of the Great Lakes. It has strong, creeping rootstocks, upright stems 2 to 4 feet high, and long, rather rigid leaves. The narrow, densely flowered panicles which terminate the stems are from 3 to 10 inches long. It is one of the most valuable grasses adapted to binding the drifting sands of our coasts, and has been cultivated for this purpose in this as well as in other countries. The action of this grass in holding the drifting sands is like that of brush or bushes cut and laid upon the ground in accumulating snow when drifted by the wind. The sand collects around the clumps of grass, and as it accumulates, the grass grows up and overtops it, and will so continue to grow, no matter how high the sand hill may rise. This process goes on over the whole surface of the plantation, and thus many acres may be raised far above their original level. A plant will, by gradual growth upwards, finally form stems and roots sanded in to the depth of fully 100 feet. Beach-grass is best propagated by transplanting (Pl. I, fig. 1). The grass is pulled by hand and planted 1 to 2 feet apart, according to the slope, by forcing a long spade or shovel into the sand, which is then carried forward, making an opening into which the roots are thrust, the spade then being withdrawn and the sand pressed close about them. The planting may be done either in the spring or fall, preferably in the fall. When propagation is by seed, the sowing should be done early in the spring and brush laid over the ground for holding the sand and seed temporarily in place. Beach-grass has been used for the manufacture of coarse paper, and it makes an excellent and very durable thatch. It is of no value for fodder.

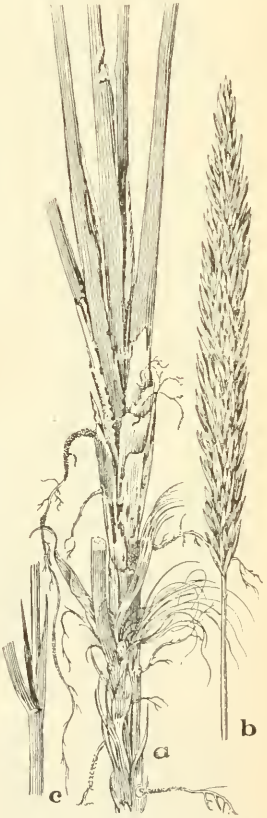


FIG. 5.—Beach-grass (*Ammophila arenaria*): *a*, base of culm; *b*, inflorescence; *c*, ligule.

No. 19. Andropogon contortus Linn. Twisted Beard-grass.

A stout, leafy perennial, 1 to 3 feet high, affording excellent grazing when young, but the mature seeds are much dreaded by sheep owners, as by their peculiar structure they not only become attached to and injure the wool, but often penetrate the skin and even the intestines of these animals. The strong rhizomes and tough fibrous roots which this grass has, commend it as a soil binder for river banks, dams, etc. The awns indicate by their twisting the amount of moisture in the air, and may be used as rain or fair weather indicators. In India this grass is used for thatching. It is a native of tropical and subtropical regions of both hemispheres, extending northward into western Texas, New Mexico, and Arizona.

No. 20. Andropogon glomeratus (Walt.) B. S. P. Brook-grass.

A stout perennial, 2 to 4 feet high, with dense, more or less elongated, broom-like panicles. It grows in low grounds and marshes from southern New York to Florida, also occurring in Mexico and Lower California. This species is esteemed a valuable pasture grass in the South. Its stems and leaves when young, are tender and juicy and are relished by stock of all kinds. Later the stems become tough and woody and are of less value.

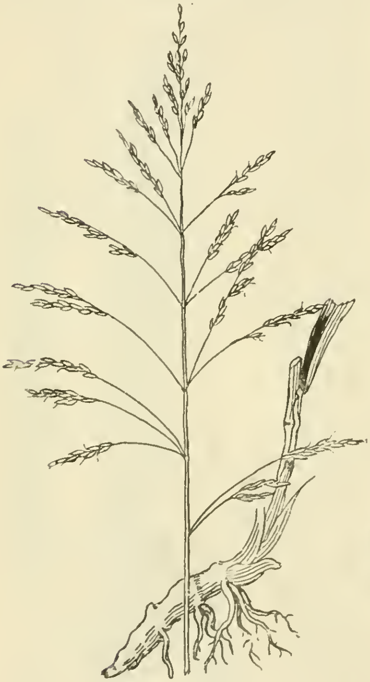


FIG. 6.—Johnson-grass (*Andropogon halepensis*).

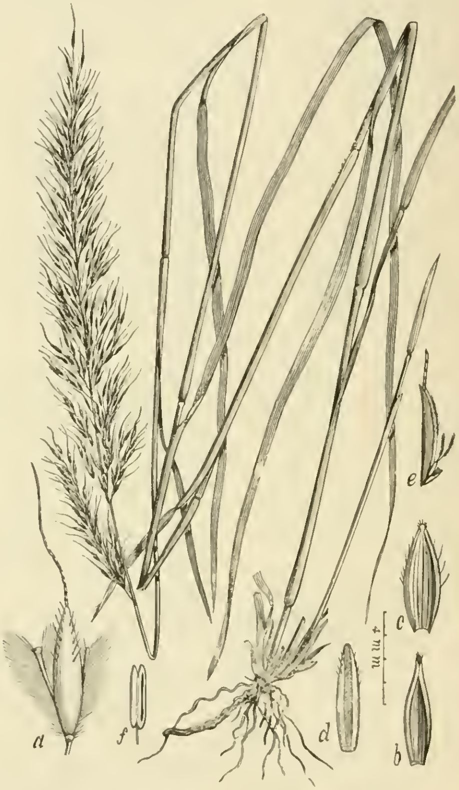


FIG. 7.—Bushy Blue-stem (*Andropogon nutans*): *a* to *f*, details of the spikelet.

No. 21. Andropogon halepensis (L.) Brot. Johnson-grass. (Fig. 6.)

A stout perennial, with smooth, erect culms, 3 to 6 feet high, and strong, creeping rootstocks. The panicles are expanded during flowering and are from 6 to 12 inches long. It is a native of southern Europe and the warmer parts of Asia and northern Africa. It was introduced into this country about sixty years ago, and has now become widely distributed and well known throughout the Southern

States. In the warmer parts of the Southern States it makes rapid growth, is but little affected by drought, and the hay, if cut just as the grass is coming into bloom, is much liked by all kinds of stock. Two or three cuttings may be made during the season. The extensively creeping rootstocks are fleshy and tender, and hogs are very fond of them. These roots literally fill the ground near the surface, and every joint is capable of developing a new stem. This grass, when once it has become established, is exceedingly difficult to eradicate, and hence has come to be greatly feared by the majority of farmers. Unless one wishes to give up his land entirely to Johnson-grass, and can certainly prevent its spreading to the lands of others, its introduction would be of doubtful economy, owing to its powerful and rapidly spreading roots. In India the natives make rude writing pens from the stems.

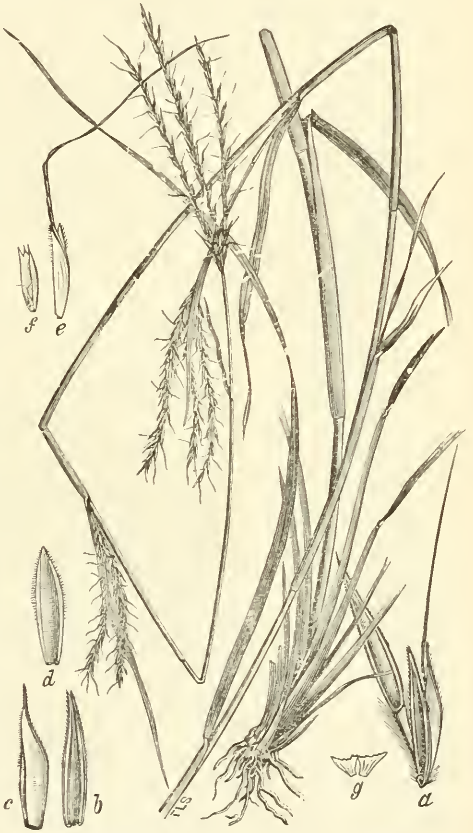


Fig. 8.—Big Blue-stem (*Andropogon provincialis*): *a* to *g*, details of the spikelet.

No. 22. Andropogon hallii Hack. Turkey-foot.

This is a stout grass, from 3 to 6 feet high, closely related to the Big Blue-stem (*Andropogon provincialis*), but appears to be confined to the sandy regions of the West. It is a good sand binder and is common in the sand hills of Nebraska, and extends southward into Texas. Its agricultural value is not known, but although more woody, it is probably nearly as valuable as Big Blue-stem.

No. 23. Andropogon nutans Linn. Bushy Blue-stem. (Fig. 7.)

This is a stout perennial, 4 to 6 feet high, growing in dry soil along the borders of fields and open woods, and on the prairies of the West it often forms a large proportion of the so-called prairie hay. It is held in little esteem in the Eastern and Southern States, but in the West it is said to make excellent hay, and is particularly valuable because of the relatively large amount of long root-leaves which it produces. All stock eat it greedily. In South Dakota it is given the first place among the native grasses as a hay-producing species, thriving best on the rich prairie bottoms. During the dry season it produces but little seed, though it usually makes a good growth of root leaves. In the middle Atlantic States this grass seeds freely and the seeds are easily collected.

No. 24. Andropogon provincialis Lam. Big Blue-stem. (Fig. 8.)

A stout perennial, with erect, more or less branching, and often bluish or glaucous stems, 2 to 6 feet high, long leaves, and flowers in short spikes, which stand two to five close together at the apex of the stem or its branches. These spikes are bluish or purple, sometimes pale green, and more or less hairy. This grass has a wide range, extending over the United States east of the Rocky Mountains, and in the West and Northwest, particularly in the Missouri region, it is very abundant, and is highly valued for hay. It grows in a great variety of soils, and under extremely varying conditions of climate, and enters largely into the composition of the hay of the prairies. The early growth consists of a great abundance of long leaves, and if cut in early bloom the hay is readily eaten by horses and cattle, but if allowed to fully mature the stems become hard and woody and the hay produced is of inferior quality. Investigations of the seed production of this *Andropogon* indicate that it matures seed rarely. It is stated that a very favorable season of moisture is required to make it fruit abundantly. This lack of fertility, if really true, will be a serious obstacle to the general propagation of the grass by the usual and convenient method of seeding.

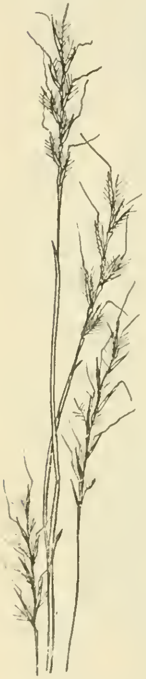


Fig. 9.—Little Blue-stem (*Andropogon scoparius*).

No. 25. Andropogon saccharoides Swz. Feather Sedge-grass.

A variable grass, growing to the height of 1 to 3 feet, with narrow, silvery-bearded panicles. Some forms of this species have been introduced into cultivation for ornament. It is a native of our Southwestern States and Territories, in some of its varieties extending southward to Chile, where it is regarded as one of the best pasture grasses of the Cordilleras.

No. 26. Andropogon scoparius Michx. Little Blue-stem. (Fig. 9.)

A rather slender perennial, 1 to 3 feet high, more or less branched above; the slender racemes are single and terminate the culm or its branches. This grass has a similar range to the Big Blue-stem, extending over nearly all of the United States east of the Rocky Mountains, and in the prairie regions it is nearly always found associated more or less abundantly with the Big Blue-stem and Bushy Blue stem. It is common in the mountain districts of the South, and is valued there for grazing. In the West it is cut for hay, but is not so much thought of as the Big Blue-stem. In South Dakota this is one of the most common grasses in the basins of the Bad Lands.

No. 27. Andropogon sorghum sativus Hack. Includes the cultivated varieties of sorghum.

Andropogon sorghum includes many varieties, a number of which have been recognized by some authors as distinct botanical species under the genus *Sorghum;* others, including Hackel, have referred them all to the genus *Andropogon.* Hackel has elaborately worked out the botanical characters of the species and characterized the known varieties, giving to each a technical name. It is not necessary here to follow out his classification, which is apparently good. In the works of others there is much confusion in the botanical classification, and still more in the application of the common or English names. The same name has been applied to different varieties and the same variety has often been designated under various names. All the forms are of Eastern origin, and have arisen probably from a common stock through ages of cultivation. From varieties of this species are obtained grain, which furnishes nutritious food for man and domestic animals, particularly poultry. Sirup and sugar in commercial quantities are obtained from the saccharine varieties. The variety *saccharatus*, or Chinese sugar-grass, yields about 13 per cent of sugar. Brooms and brushes, used in all civilized countries, are made from the inflorescence of the variety known as broom corn, and all furnish fodder of more or less value for farm stock. In Africa alcoholic drinks are prepared from the grains, and useful coloring pigments are contained in the fruiting glumes. The variety known as Kafir corn (Pl. I, fig. 2), which grows to the height of 4 or 6 feet, has been cultivated with great success as a fodder plant in the semiarid regions of the West. In fact, all the sorghums will grow in drier climates or under more trying conditions of drought than Indian corn. They may be cultivated in much the same way as that cereal, but the seed may be planted more thickly. In chicken corn or white Egyptian corn (var. *cernuum*) the densely flowered panicle is abruptly bent or recurved, so that it points downward. This variety is largely cultivated in tropical and northern Africa and in some parts of southern Asia, where it is used as a cereal. It is occasionally grown in this country, the seed being prized as food for poultry. The varieties adapted for the production of fodder or silage are particularly valuable for cultivation in the South and Southwest. The amount of fodder produced is often very large, of excellent quality, and there are few among the larger grasses better adapted for soiling. Yellow Milo Maize, White Milo Maize, and Jerusalem Corn, nonsaccharine varieties of *Andropogon sorghum*, are grown both for fodder and for the seed, particularly in the Southwestern States.

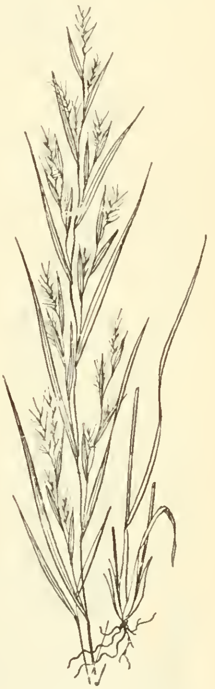


Fig. 10. — Broom Sedge (*Andropogon virginicus*).

No. 28. Andropogon squarrosus. Linn. fil. Vetivert.

A stout perennial, 4 to 6 feet high, with strong, fibrous, and highly fragrant roots. A native of India, occurring also in some of the West India Islands and Brazil, growing in marshes and on river banks. Introduced into Louisiana many years ago, and now spontaneous in some of the lower parts of that State. Cultivated successfully at Knoxville, Tenn., where the fragrance of the rhizomes and roots was developed to a marked degree, but the plants did not bloom. In India this grass is largely used for thatching, and is woven into mats, which serve as screens or shades for doors and windows (tatties), awnings, covers for palanquins, and fans, and brushes used by weavers in arranging the thread of the web are made from either the roots or the whole plant. The roots, laid among clothing, impart a pleasing fragrance to the garments and are said to keep them free from insects. Fans made from the root fibers were among the articles on sale at the World's Fair in the Javanese bazaar. The roots are an article of commerce sold by druggists. In European drug stores the roots are known as *Radix anatheri* or *Radix vetiveriæ*, a stimulant or antiseptic. They yield a perfume known as *vetivert*, or, in India, *itar*.

No. 29. Andropogon virginicus Linn. Broom-sedge. (Fig. 10.)

A rigidly erect perennial, 2 to 4 feet high, bearing a narrow, elongated, and loosely-branched panicle of silky-bearded racemes. The stems are strongly flattened near the base, and at maturity they are too hard and woody to be eaten by stock or to be of any value for hay. When young, however, this grass affords most excellent grazing. Milch cows fed upon it are said to yield butter of superior quality. There is probably no native grass better known to the farmers of the South than this, and although possessing some value, as here indicated, it is, broadly speaking, one of the worst weeds of that section, interfering seriously with the formation of permanent meadows. Constant tillage or very close grazing appears to be the only means of keeping this grass from occupying the land.

No. 30. Anthoxanthum odoratum Linn. Sweet Vernal-grass. (Fig. 11.)

A perennial, early-flowering, sweet-scented grass, introduced into this country from Europe, and now widely distributed over the Eastern and Central States. It is an inferior fodder grass, but owing to its earliness it possesses some value in mixtures for pastures, and its sweet scent adds a pleasing fragrance to hay, of which it should form only a small percentage. The leaves have a bitter taste, and the grass is apparently unpalatable to stock, for they will not readily eat it. It is regarded as a serious pest in New Zealand. The stems have been used in the manufacture of imitation Leghorn hats. Average number of grains in 1 pound of pure seed, 924,000. Price of seed quoted in New York catalogues, $6 per bushel. Weight per bushel, about 10 pounds.

No. 31. Aristida fasciculata Torr. Needle-grass. (Fig. 12.)

Needle-grass grows from 6 inches to a foot high, and is a native of the arid regions, from Montana southward to Texas, where it is particularly abundant in poor soils, and presents a great variety of forms. It is usually found in dry, gravelly soils on the plains, mesas, and foothills. In the Eastern and Middle States the species of *Aristida* are deemed of little or no value, but in the Southwest, where every mouthful of fodder of any sort has value, they are not wholly worthless. *Aristida schiedeana* and *A. bromoides*, growing upon rocky and desert soil in Arizona and New Mexico, supply in their thin, scattered tufts "dainty bits seized upon by stock with avidity." (Pringle.)

No. 32. Aristida stricta Michx. Wire-grass.

This is one of the "wire-grasses" of the Southern States, growing to the height of 2 or 3 feet. The simple stems are terminated by a narrow panicle, usually a foot in length. It is common along dry, sandy ridges and in the pine barrens.

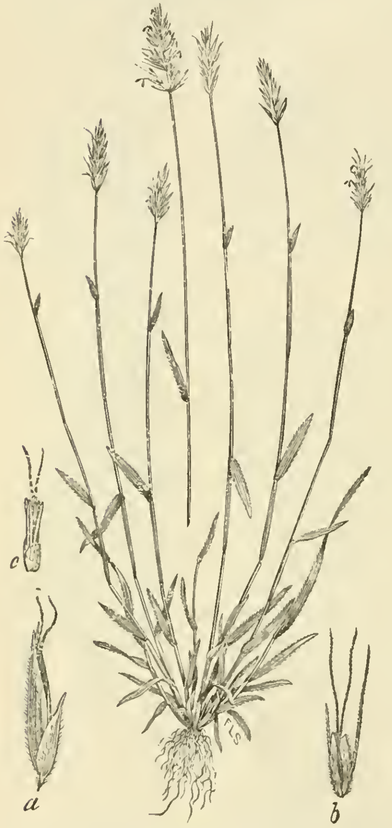


Fig. 11.—Sweet Vernal-grass (*Anthoxanthum odoratum*): *a*, spikelet; *b*, floret; *c*, androgynecium.

No. 33. Arrhenatherum elatius (L.) M. & K. Tall Oat-grass. (Fig. 13.)

A loosely tufted perennial, 2 to 4 feet high, introduced from Europe as a fodder grass and now quite generally distributed over the regions east of the Mississippi. In Europe it is regarded as one of the best meadow grasses, but is not recommended for pastures. It does well in the Southern States, where it is frequently cultivated, and is valued both for winter grazing and for hay. In California it is spoken of in the highest terms, particularly for its drought-resisting qualities. It does not form a very compact turf, and when sown should be mixed with other grasses. It grows rapidly, blooms early, and when cut dries out readily. It is not suited to heavy, moist soils, but thrives best on loamy sands or loams. It produces a large yield, and on good soils three or four cuttings may be obtained during the season. It is best sown in the spring, but in the Southern States it may be sown in September to advantage. In New Zealand this grass is spoken of as fast becoming a weed in mixed pastures; and, further, it is stated that the early growth is much relished by stock, but later in the season it is not touched. On rich, clayey loam this grass has made a yield of 17,015 pounds of green fodder, 6,380 pounds of hay, and 13,612 pounds of green aftermath per acre. When sown alone, the amount of seed to sow per acre is 5 to 6 bushels. Owing to the structure of the seed, it may be sown deeper than most other grasses. Average number of grains in one pound of pure seed, 159,000. Price of seed, quoted from New York catalogues, $3.25 per bushel, or $18 per 100 pounds.

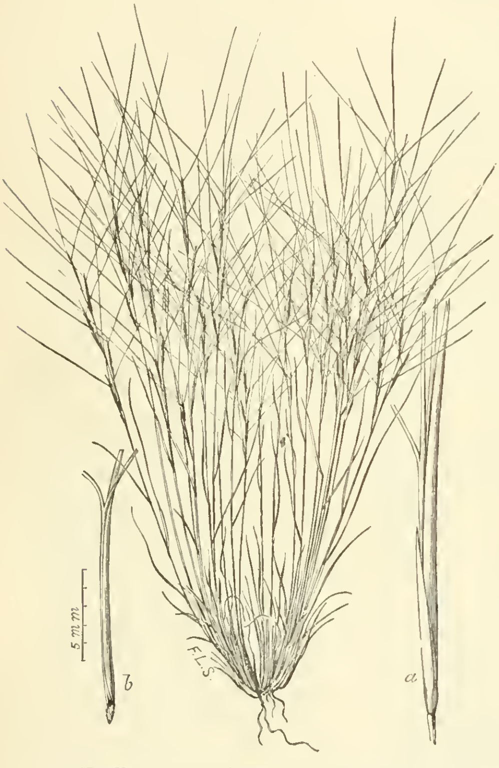


FIG. 12.—Needle-grass (*Aristida fasciculata*): *a*, spikelet; *b*, indurated flowering glume, the awns cut off.

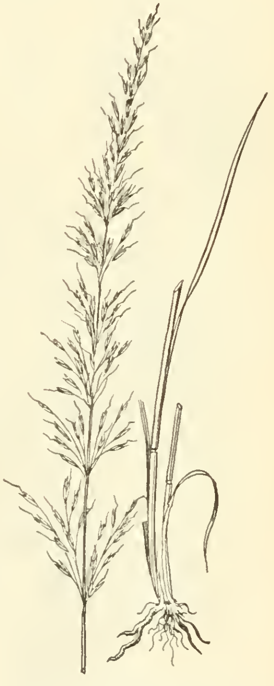


FIG. 13.—Tall Oat-grass (*Arrhenatherum elatius*).

No. 34. Arundinaria macrosperma Michx. Cane. (Fig. 14.)

This is the bamboo which forms the well-known canebrakes of the South. It is perennial, with woody stems 10 to 30 feet high, and evergreen leaves, which furnish a valuable supplement to the winter pastures. The plant blooms but once, and when the seeds mature the cane dies. The canes are used for many purposes, such as fishing rods, scaffolds for drying cotton, splints for baskets, mats, etc. Attempts made to cultivate this grass have not been successful.

No. 35. Arundinaria tecta (Walt.) Muhl. Small Cane.

This is regarded by some as only a variety of the cane mentioned above, but it is of smaller growth, rarely exceeding 10 feet in height, and extends as far north as Maryland. It forms extensive "canebrakes" in many parts of the Southern States, and its perennial leafage, together with the younger stems and branches, supply forage for thousands of cattle during the winter season. This fodder, however, does little more than sustain the life of the animals. It is of little or no value for fattening cattle or for milch cows.

No. 36. Arundo donax Linn. Reed.

A tall, leafy perennial, attaining the height of 10 to 15 feet, or in very favorable locations even 30 feet. The leaves are broad and widely spreading and the stems are leafy to near the top. The panicle has some resemblance to that of pampas grass, but is not so large. This grass is grown for lawn decoration and to conceal unsightly objects. It is a native of southern Europe, northern Africa, and western Asia, and is said to be spontaneous along the Rio Grande. In some countries the stout stems are used for laths and, when split, for woven work; the leaves are used for thatch or roofing, and the stout rhizomes are employed as a diuretic. A cultivated variety has its broad leaves striped with longitudinal white bands. It presents a very striking appearance. This grass is propagated by transplanting the roots, which work may be done at any time during the season. After growth has fairly commenced the subsequent development is very rapid, and for this reason it is one of the most important plants of its class for quickly producing scenic effects or for concealing unsightly objects.

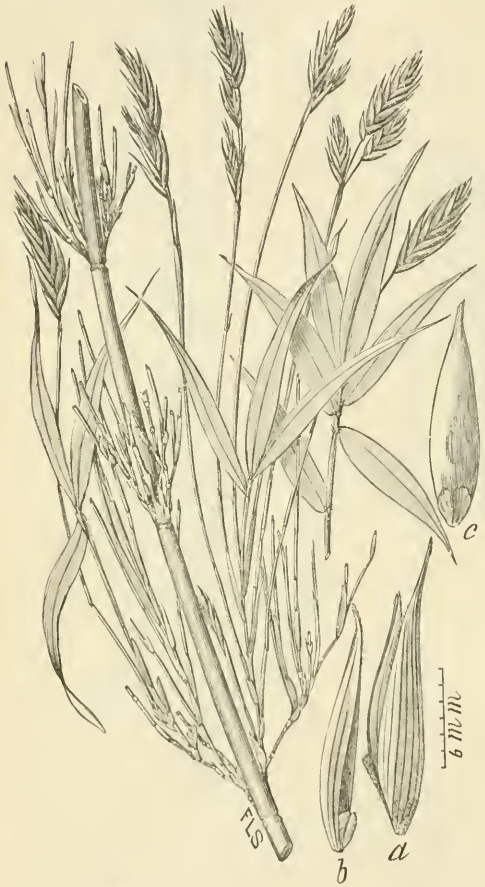


FIG. 14.—Cane (*Arundinaria macrosperma*): *a*, floret; *b*, palea and lodicules; *c*, grain.

No. 37. Astrebla pectinata F. v. Muell. Mitchell-grass.

A smooth, erect grass, 1½ to 3 feet high, with flat, long-pointed leaves and densely flowered terminal spikes or heads. It is a native of Australia, growing naturally upon the interior plains. It is regarded by the stockmen of that country as the best of all native grasses, both for its drought-enduring qualities and for its fattening properties. If cut just when coming into bloom, it makes excellent hay. The seed is produced in abundance, and is easily collected. This may prove a valuable grass for the semiarid districts of the Southwest. The seeds of this grass, as well as those of the closely related *Astrebla triticoides*, were formerly used as food by the natives of Australia.

No. 38. Avena americana Scribn. American Oat-grass.

In the grassy parks and on the foothills of the eastern slopes of the Rocky Mountains, this *Avena*, which closely resembles the *Avena pratensis* of Europe, is frequently found associated with the other native grasses. Where abundant it makes a valuable addition to the grazing resources of the country. It is deserving of a trial under cultivation.

No. 39. Avena fatua Linn. Wild-oats. (Fig. 15.)

An erect annual, 2 to 3 feet high, with loose, open panicles, 8 to 10 inches long, the whole aspect of the plant closely resembling forms of the cultivated oat. The spikelets are larger, however, and the flowering glumes are covered with long, brown hairs, and have a twisted awn an inch in length. It is a native of the Mediterranean region, but is now widely distributed over grain-growing countries, and with the closely related *A. barbata* Brot. is especially common in California and Oregon, and has spread eastward to Minnesota. It is of rare occurrence in the Eastern States. By some this is supposed to be the original of the cultivated oat (*Avena sativa*), which is said to readily degenerate into it. *Avena fatua* is in most places regarded as a troublesome weed. When abundant in the grain fields, it occupies the place of better plants, and reduces the grade of the thrashed grain by the admixture of its inferior and lighter seeds. The stiff and twisted awns are injurious to stock, as they frequently cause irritation of the nostrils and mouths of the cattle feeding upon them. In California the young plants, before the bearded or awned spikelets mature, are esteemed for grazing and forage. "The use of the Wild-oat, with its brown, hairy seed and twisted awn, as an artificial fly by fishermen, is well known, the uncoiling of the awn when wetted causing those contortions by which it imitates a fly in trouble." (Hooker.) A form of the Wild-oat with the flowering glume smooth (var. *glabrescens* Coss.) is quite widely distributed on the Pacific Slope, where it has become a most troublesome weed in wheat fields.

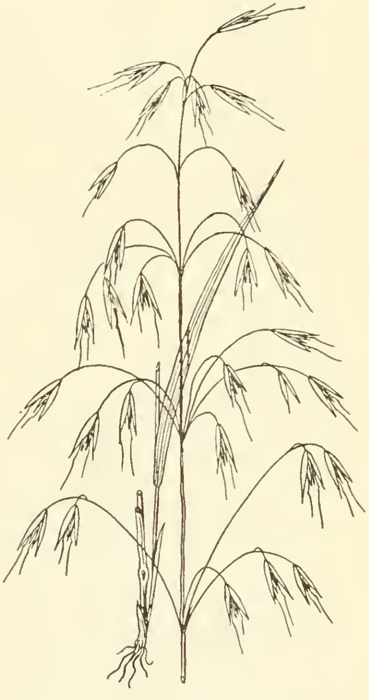


FIG. 15.—Wild Oats (*Avena fatua*).

No. 40. Avena pubescens Linn. Downy Oat-grass.

This grass is similar in habit and appearance to *Avena fatua*, but is much less common. It is a European grass, and has thence been introduced into this country. It is occasionally found in the grain region of the Pacific Slope. The soils best suited to the growth of this grass are sandy loams, upon which it is valuable for early mowing and pasturage Under favorable conditions it has produced 15,654 pounds of green fodder, or 5,870 pounds of hay, and 6,860 pounds of aftermath per acre.

No. 41. Avena sativa Linn. Oats.

A well-known erect annual, 2 to 4 feet high, with flat leaves and expanded panicles of rather large pendulous spikelets. There are many varieties, which have been divided into two classes, "panicle oats" with widely spreading panicle branches; and "banner oats" with the panicles somewhat contracted and one-sided. These two races are divided into "chaffy" and "naked-fruited" sorts; further varieties are established upon the color, form, or some special character of the grain. Oats have been cultivated from very early times in Europe, and they form the principal grain of such northern countries as Norway and Sweden, and Scotland, and in these countries boiled oatmeal and oatmeal cakes are important articles of food. Boiled oatmeal is also much used in this country, especially at breakfast. The grain, however, is principally cultivated here as food for horses. In the Southern States, oats, particularly winter oats, are largely grown for forage. Sown in August, they furnish the best grazing from October to the latter part of April, and will then yield a more certain and a larger crop of grain than spring-sown oats. They are often cut green for soiling and for hay. Oat hay is quite extensively used in the South and in California. The practice is to cut when the grain is in the "dough" stage, or when the straw commences to turn yellow below the head and the leaves are still green. The yield ranges from 3 to 4½ tons per acre, according to the variety and the season. The feeding value of oat hay is higher than that of timothy, containing about 8.8 per cent of crude protein, and 55 to 65 per cent of fat formers, while the latter (timothy) contains from 5 to 7 per cent crude protein, and 45 to 55 per cent fat formers. Among the cereals, oats are the most nutritious, but oaten flour lacks the gluten of wheat, rendering the making of bread from it impossible. Oatmeal is richer in nitrogenous matter than soft wheats, and contains more fat than any of the other grains. Russian "quas" beer is made from oats.

No. 42. Avena sterilis L. Animated Oats.

A stout, oat-like grass, with one-sided panicles, and very large, awned spikelets; the awn is very long, twisted, and "kneed" or geniculate. It is the twisting and untwisting of these awns when exposed to changes of moisture and dryness that has given to this grass the common name of "animated oats." The untwisting or coiling-up of the awn causes the spikelets to tumble about in various directions, suggestive of independent motion or life-like activity.

No. 43. Bambusa. Bamboo.

The bamboos belong to the *Bambuseæ*, a tribe of grasses numbering about 175 species, chiefly limited to South America, southern and eastern Asia, and the East Indies. There are no European species, and only two in North America (see *Arundinaria*). Of the whole number of species only one is common to both hemispheres. The largest bamboos attain a height of 120 feet, with a diameter of a foot or more. A South American species has leaves 3 to 12 inches wide and 5 to 15 feet long. In India are extensive bamboo forests, and in countries where these grasses abound they are employed for many purposes. They furnish material for the complete construction and furnishing (including domestic utensils) of houses. They are used in shipbuilding and in the construction of bridges. Buckets, pitchers, flasks, and cups are made from sections of the stems. Baskets, boxes, fans, hats, and jackets are made from split bamboo. Ropes and Chinese paper are made from these grasses. A Chinese umbrella consists of bamboo paper, with a bamboo handle and split bamboo for a frame. The leaves are used for packing, filling beds, etc., and occasionally serve as fodder for stock. The young shoots serve as a vegetable. Tabashir, or bamboo manna, a silicious and crystalline substance which occurs in the hollow stems of some bamboos, is regarded as possessing medicinal properties. Good drinking water collects in quantities in the hollows of the internodes of many of the larger bamboos. All sorts of agricultural implements, appliances for spinning cotton and wool or for reeling silk, are often constructed entirely from bamboo. Very many articles of household use or decoration made from bamboo have become articles of commerce in Europe and this country. So many and varied are the uses of the several species of bamboo, that it is possible to mention here only a small part of them. Bamboos are propagated by seed, but more often by cuttings. Plants from the seed do not attain a sufficient growth to admit cropping under 10 or 12 years.

No. 44. Beckmannia erucæformis (L.) Host. Slough-grass. (Fig. 16.)

A stout, erect, subaquatic perennial, 1 to 4 feet high, with narrow, densely flowered panicles. The leaves are broad and flat, and the stems are coarse but tender, becoming somewhat woody when old. It grows along the banks of streams and rivers and frequently follows the course of the irrigating ditches. When young, however, this grass is palatable and readily eaten by stock. In some portions of the Northwest, to which region this grass is confined in this country, it often occurs in such quantities as to constitute an important part of the forage of low pasture lands. It may be recognized by the peculiar, spike-like branches of the panicle, which have some resemblance to the rattles of a rattlesnake, and for this reason it is sometimes called "Rattlesnake-grass." It is deserving of trial under cultivation for low meadow lands in the more Northern States, and is especially adapted to irrigated alkaline lands.

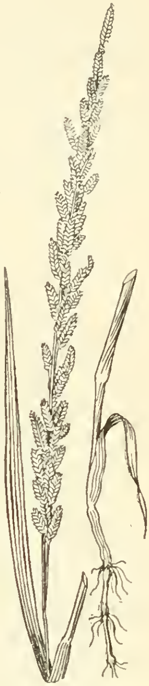


FIG. 16.—Slough-grass (*Beckmannia erucæformis*).

No. 45. Bouteloua curtipendula (Mx.) Torr. Side Oats. (Fig. 17.)

This is among the tallest of our species of *Bouteloua*, the rather stout, tufted stems being from 1 to 3 feet high. It has tough, perennial, fibrous roots, flat, long-pointed leaves, and many short spikes arranged along the upper portion of the stem. Its range extends from New Jersey westward to the Rocky Mountains and southward through Texas into Mexico. Where abundant, it is said to make fair hay, and the numerous root leaves afford good pasturage. The hay is readily eaten by stock, but on the range cattle show a decided preference for Blue Grama. Several species of Grama have been successfully grown in small cultures at some of the experiment stations, but none of them, although apparently most valuable as pasture grasses for the semiarid regions, have been introduced into general cultivation.

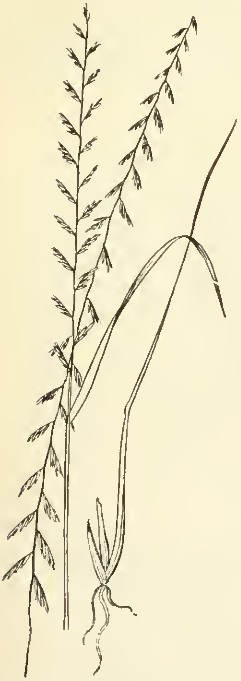


FIG. 17.—Side Oats (*Bouteloua curtipendula*).

No. 46. Bouteloua eriopoda Torr. Black Grama.

This is one of the species of Grama so valuable for grazing in New Mexico and Texas. The slender stems are 1 to 2 feet high, and from its thrifty habit of growth it forms dense and excellent pasturage wherever it grows abundantly. It is a common grass along the Rio Grande and in the region between the Pecos and the Gila; also in the Olympia, Guadalupe, and Eagle mountains, and on the Staked Plains in Texas. The woolly-jointed stems at once serve to distinguish this from the allied species of *Bouteloua*.

No. 47. Bouteloua oligostachya (Nutt.) Torr. Blue, or White Grama. (Fig. 18.)

This is one of the most abundant and most valued of the Grama grasses, and extends from Wisconsin westward to California, and southward into Texas and northern Mexico. It is a perennial, 6 to 18 inches high, its strong rhizomes and numerous root-leaves forming dense and more or less extensive patches of excellent turf. In Montana it is known as Buffalo-grass. It frequents the bench lands of that State, growing at elevations of from 3,000 to 4,000 or 5,000 feet, and not infrequently covers wide areas. No other grass better withstands the tramping of stock, and it is unsurpassed for grazing purposes. In the early days in the Southwest it formed a large proportion of the hay delivered at the various military posts and stage stations, and was considered the best obtainable there. Like the true Buffalo-grass, it cures during the dry season in the turf into perfect hay, losing none of its nutritious properties.

No. 48. Bouteloua polystachya Torr. Low Grama.

This is a small, slender grass, of good quality. It is one of the smallest of the Gramas, and only occurs sparingly here and there in scattered tufts. It rarely exceeds 6 inches in height, and is confined to the arid regions of the Southwest.

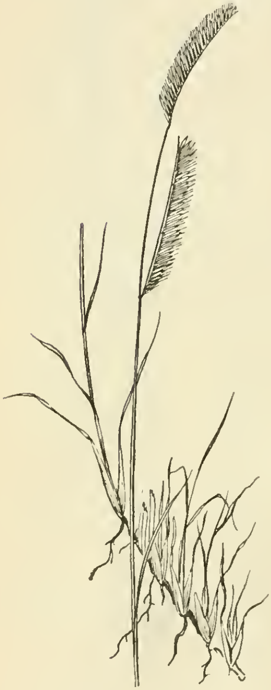


FIG. 18.—Blue, or White Grama (*Bouteloua oligostachya*).

No. 49. Bouteloua repens (HBK.) Scribn. Creeping Grama.

A common grass in the vicinity of Acapulco, Mexico, where, according to Dr. E. Palmer, it occurs on the highest mountains and down their stony slopes to the water's edge. Greedily eaten by stock.

No. 50. Bouteloua texana Watson. (Seed Mesquit.)

This is a small but excellent grass, common about San Antonio and at other points in Texas, chiefly along the Rio Grande. It is recognized as an important grass in the stock ranges.

No. 51. Brachypodium japonicum Miq. Japanese Wheat-grass.

A promising Japanese perennial, closely resembling Bearded Wheat-grass (*Agropyron caninum*), but of rather stronger growth. It was introduced into California by the Agricultural Experiment Station of the University of California, at Berkeley, from New Zealand, in 1886, and the first seed was distributed in California in 1889. It has been cultivated with success at a number of points in California and at several of the experiment stations in the East. In the Southern States it is regarded as a valuable grass for winter grazing, as it makes its best growth during the cooler months.

No. 52. Briza media Linn. Small Quaking-grass. (Fig. 19.)

An erect perennial, from 1 to 2 feet high, introduced into this country from Europe because of its pleasing ornamental appearance. It has escaped from cultivation in many places, and has become sparingly naturalized. It is occasionally cultivated for ornament; the nodding panicles of rather showy spikelets are used for winter bouquets. It is but little known here, but is classed as a valuable meadow grass in Middle Europe and is recommended as an admixture for pastures on dry, thin soils. *Briza minor* is a smaller and more delicate annual species, also cultivated occasionally as an ornamental and for dry bouquets. *Briza maxima*, also an annual, is a larger ornamental species.

No. 53. Bromus ciliatus Linn. Swamp Chess.

A native perennial of wide range, frequent in open woodlands, growing to the height of 3 to 5 feet. It is leafy to the top, and would doubtless make a hay grass of good appearance, although of somewhat inferior quality. No attempts have been made to cultivate it for agricultural purposes. It makes a vigorous early growth on good soils and is recommended for propagation in wooded parks and woodland pastures.

No. 54. Bromus inermis Leyss. Smooth Brome-grass. (Fig. 20.)

An erect perennial, 2 to 5 feet high, with strong creeping rootstocks, and a loose open panicle, 4 to 6 inches long. A native of Europe introduced into this country by the Agricultural Experiment Station of the University of California about 1880, which gives considerable promise of value both for hay and pasturage. It is strongly stoloniferous, and quickly makes a thick, firm turf. It appears to grow with equal vigor in Canada and in Tennessee, remaining green throughout the winter season in the latter State. The strong perennial character of this Brome-grass and its unusual drought-resisting powers are qualities which recommend it for general cultivation, particularly in the semiarid regions of the West and Northwest. It thrives well on dry, loose soil, but of course the better the soil the greater the yield. Its nutritive value is comparatively low, and before undertaking its cultivation the fact should be remembered that it is somewhat difficult to eradicate when once established, although by no means so difficult as Couch-grass or Johnson-grass. In Europe it is classed among the best hay grasses. The seeds are quoted in New York catalogues at from $20 to $22 per 100 pounds. A bushel weighs about 14 pounds. Sow two bushels to the acre if sown alone. In this country the yield of seed per acre has been 600 pounds, which at the prices named would make it a very profitable crop. Professor Fletcher, of Canada, reports a yield of 3¾ tons of hay per acre.

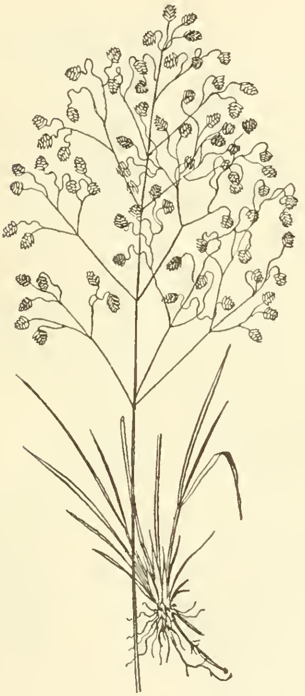


FIG. 19.—Small Quaking-grass (*Briza media*).

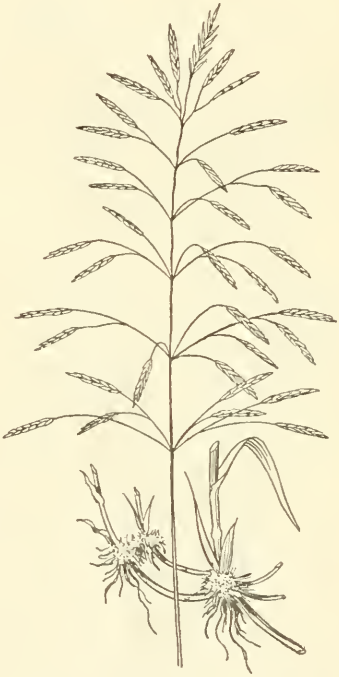


FIG. 20.—Smooth Brome-grass (*Bromus inermis*).

No. 55. Bromus pumpellianus Scribn. Western Brome-grass.

A native of the Northwestern States in the Rocky Mountain region, extending into Canada. In habit of growth it closely resembles Hungarian, or Smooth Brome-grass (*B. inermis*), and is doubtless equally valuable. Prof. James Fletcher, who has cultivated this grass at the experiment station at Ottawa, Canada, says, "This is a very valuable grass, producing an abundance of leaves, continuing in flower for a long time, and giving a heavy aftermath."

No. 56. Bromus racemosus Linn. Upright Chess.

An introduced annual, 1 to 3 feet high, with more or less spreading and nodding panicles and smooth spikelets. This is a very common grass in cultivated fields and waste places, and is often mistaken for Chess, from which it differs chiefly in its narrower panicles and straight awns, which are nearly as long as the flowering glumes. This grass has become very common in certain sections, particularly in the South. A field of it presents an attractive appearance, and the hay produced is of good quality.

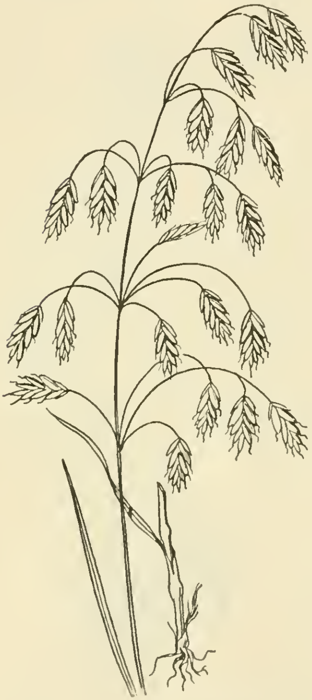


Fig. 21.—Chess (*Bromus secalinus*).

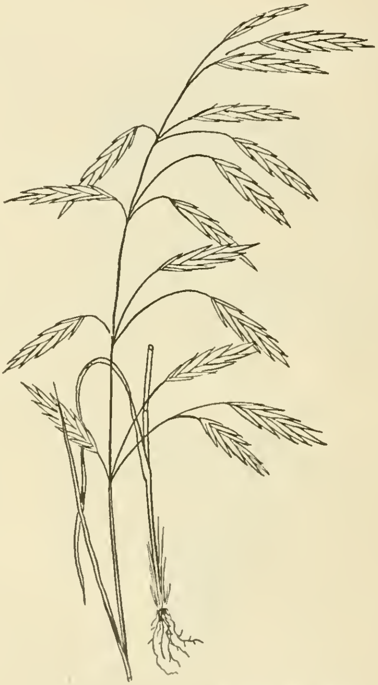


Fig. 22.—Rescue-grass (*Bromus unioloides*).

No. 57. Bromus secalinus Linn. Chess; Cheat. (Fig. 21.)

A well-known, weedy, annual grass, introduced into this country many years ago, and now common in grain fields and waste lands. The panicle is spreading and more or less drooping, and the awns of the flowering glumes are usually much shorter than the glumes themselves and more or less flexuose. The idea that Cheat or Chess is degenerated wheat has no foundation whatever in fact. Only Cheat seeds will produce Cheat, and it is certain that wherever these plants appear they were preceded by Cheat seeds, which may have been introduced with the grain sown, or brought by birds or animals from other fields. Cheat and wheat are only remotely related; they belong to quite distinct tribes in the grass family; wheat is less likely to change into cheat in a single generation than into the more nearly allied oats, or than wheat is to change into barley, with which it is very closely related.

No. 58. Bromus unioloides Willd. Rescue-grass. (Fig. 22.)

This *Bromus*, which is a native of South America, and probably also of the extreme southwestern portion of the United States, is a strong-growing grass, with rather broad, much flattened, usually bearded spikelets. It grows to the height of 1 to 3 feet, and in the more vigorous plants the branches of the nodding panicle are widely spreading. It grows rapidly, seeds freely, and dies after seeding. If, by frequent mowing or close grazing, it is prevented from going to seed, its duration may be continued over two or three years or more. If the seeds are allowed to fall, as they frequently do when mature, young plants soon appear, and a fairly continuous growth of this grass may thus be maintained. In many parts of the Southern States, where it has been most cultivated, it has come to be regarded as one of the best winter grasses, as it makes its chief growth during the cooler months of the year. Sow in August or September, at the rate of 30 to 40 pounds to the acre.

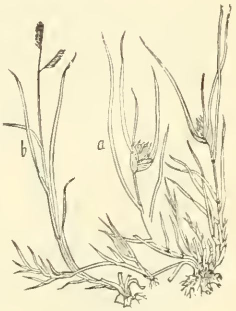


Fig. 23.—Buffalo-grass (*Bulbilis dactyloides*). *a*, female plant; *b*, male plant.

No. 59 Bulbilis dactyloides (Nutt.) Rafin. Buffalo-grass. (Fig. 23.)

This is the true Buffalo-grass of the Great Plains region, which is reported to have been much more abundant and more widely distributed in times past than it is at present. Now, however, it is known to extend from the British Possessions southward into Texas, where it is considered an invaluable grass and one of the best constituents of sheep pastures. It has a low habit of growth, rarely more than 5 or 6 inches high, and produces numerous creeping and widely spreading branches or stolons, which root at the joints, each joint forming a new tuft, and in this way the grass often covers large areas with a close mat of fine-leafed herbage, which is greatly relished by all grazing animals. As a winter forage, it is without an equal. The habit of growth of this plant is very similar to that of Bermuda-grass, but the stems and leaves are much finer and the turf formed more compact. Live roots transplanted from Nebraska to the grounds of the Department of Agriculture at Washington, D. C., have grown with remarkable vigor, and it may be possible to utilize this most palatable and nutritious grass in portions of the Eastern or Southern States.

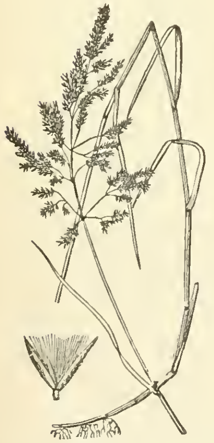


Fig. 24.—Blue-joint (*Calamagrostis canadensis*).

No. 60. Calamagrostis canadensis (Michx.) Beauv. Blue-joint. (Fig. 24.)

A native grass common in the Northern and Northwestern States, extending clear across the continent, usually growing in moist meadows. The leafy stems are 3 to 5 feet high, and the open brown or purplish panicles have some resemblance to those of Redtop. Occasionally it is found occupying considerable areas to the exclusion of other grasses, and under such conditions it yields a large amount of excellent hay, highly prized by farmers and eaten with avidity by all farm stock. This grass grows naturally on low, moist meadows, and has succeeded well under cultivation. In the northern portion of the United States its more extended culture for hay is recommended.

No. 61. Calamagrostis cinnoides (Muhl.) Spreng. Reed Bent-grass.

A stout, reed-like grass, 3 to 5 feet high, not infrequent in low, moist grounds and swamps, ranging from New England southward to Tennessee. No attempts have been made to cultivate it, and little is known of its agricultural value. Probably of some use for low woodlands where grasses are desired for pasturage, and if it will thrive in the open it would make a most excellent hay-grass for low meadows.

No. 62. Calamagrostis hyperborea americana (Vasey) Kearn. Yellow-top.

A very common grass in low meadows and shady river banks throughout the Northwest. It affords a large amount of excellent hay if cut in proper season. A good grass for cultivation in moist, sandy meadows.

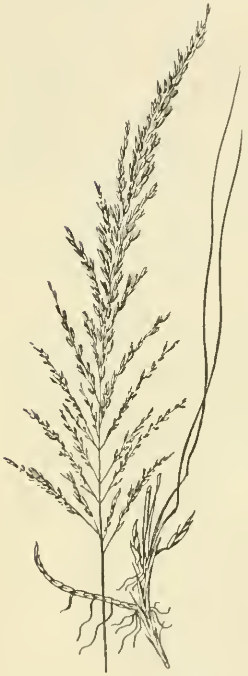


FIG. 25.—Sand-grass (*Calamovilfa longifolia*).

No. 63. Calamagrostis neglecta (Ehrh.) Gaertn. Pony-grass.

A rather slender, erect perennial, with narrow leaves, and a contracted, densely flowered, brownish panicle, 3 to 6 inches long. A native of Northern Europe and North America, ranging along our northern borders from Newfoundland and Maine to the Pacific, being most abundant in the Rocky Mountain region. Under experimental cultivation it has succeeded well. It is a productive grass, much liked by stock, especially horses, and is deserving a place among the cultivated species.

No. 64. Calamagrostis suksdorfii Scribn. Pine-grass.

A rather slender, erect grass, 2 to 3 feet high, with smooth stems, narrow leaves, and contracted, usually pale, straw-colored panicles. A common grass in the Northwest, growing in low pine woods or on moist mountain slopes. It is said to be one of the most common grasses in Washington, and it presents all the qualities of an excellent hay or pasture grass.

No. 65. Calamovilfa longifolia (Hook) Scribn. Sand-grass. (Fig. 25.)

A stout, long-leafed grass, 1 to 4 feet high, growing in sands or sandy soil along the shores of the Great Lakes and in the Missouri region of the West, extending southward to Kansas. Its very strong and far-reaching rhizomes or creeping "roots" make this an exceedingly valuable grass for binding drifting sands, or those subject to wash by swift currents or the beating of the waves. As a sand binder for interior regions of the country this grass is probably unsurpassed. Its long, tough leaves suggest a possible value for paper making.

No. 66. Campulosus aromaticus (Walt.) Scribn. Toothache-grass. (Fig. 26.)

A perennial grass with erect stems 3 to 4 feet high. Native of the Southern States from Virginia southward, growing in the wet pine barrens, possessing no agricultural value, but rather curious in appearance. The strong rootstocks are lemon-scented and have a pungent taste.

No. 67. Cenchrus echinatus Linn. Cock-spur.

A rather stout annual, with branching culms 1 to 2 feet long, and dense heads or spikes made up of 20 or more globular, spiny burs containing the spikelets. It is a weed of the fields and waste places of the Southern and Southwestern States.

No. 68. Cenchrus tribuloides Linn. Sand-bur. (Fig. 27.)

A widely distributed grass growing in sandy soils along river banks, the seashore and more or less scattered throughout the interior of the country in sandy districts. It is one of the worst of annual weeds wherever it becomes abundant. The prostrate branching stems are 1 to 2 feet long; the spikes are composed of 10 to 15 strongly spiny burs, which readily become detached and adhere to passing objects. No pains should be spared in efforts to exterminate this grass wherever it makes its appearance.

No. 69. Chætochloa glauca (Linn.) Scribn. Yellow Foxtail. (Fig. 28.)

An erect annual, 1 to 2 feet high, with flat leaves, and a bristly, cylindrical, spike-like, densely flowered panicle 1 to 3 inches long. This grass is widely distributed throughout the tropical and warmer temperate regions of the world, growing as a weed in cultivated grounds. It is especially common in the Southern States, where it continues to bloom throughout the season, from June to October. It is distinguished from *Setaria viridis* by its somewhat larger spikelets and more widely spreading yellowish bristles.

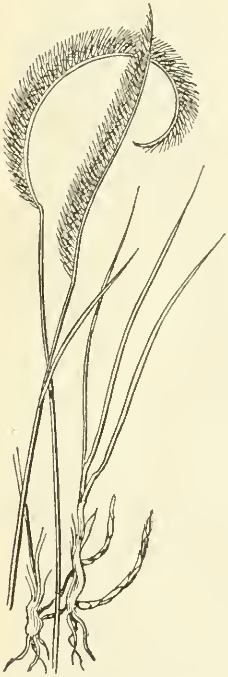


Fig. 26. — Toothache-grass (*Campulosus aromaticus*).

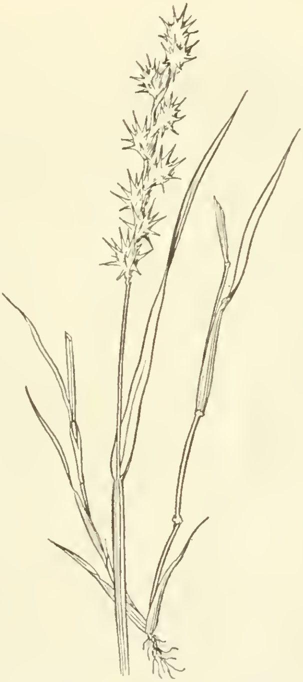


Fig. 27.—Sand-bur (*Cenchrus tribuloides*).

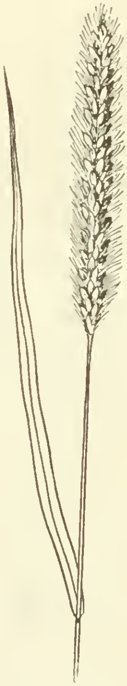


Fig. 28. — Yellow Foxtail (*Chætochloa glauca*).

No. 70. Chætochloa italica (Linn.) Scribn. Millet; Hungarian-grass. (Fig. 30.)

This grass, in some of its varieties, has been cultivated in the East for many centuries, and in some parts of India and Trans-Caucasia it still forms an important article of food. Its culture extends back to an early date in Egypt, and in the lake dwellings of the stone age it is found in such quantities that it must be regarded as the main bread supply of the prehistoric peoples (Hackel). In Europe and in this country it is cultivated to some extent for fodder and for the seed, the latter being used chiefly for fowls. It grows rapidly, and may be cut within sixty or sixty-five days from the time of sowing. If used for fodder, it should be cut just as it begins to head, before blooming, for when more advanced it is apt to be injurious to stock fed upon it. When cut in good season it is one of the most valuable of soiling plants. German Millet (fig. 29) is only a variety of *Chætochloa italica*, distinguished by its smaller, more compact, and erect heads, the bristles of which are usually purplish. Sow 2 to 3 pecks per acre for hay. One peck is sufficient when sown for seed.

No. 71. Chætochloa magna (Griesb.) Scribn. Giant Millet. (Pl. II.)

This native millet grows in swamps along the coast from Florida to Delaware. The leaves are very broad and long, and the stems are often 8 or 10 feet in height. It is one of the most promising grasses for use in the reclamation of swampy lands along the coast. It has been grown successfully in the grass garden on the Department grounds. A single plant, with much branched stems, is shown in Pl. II.

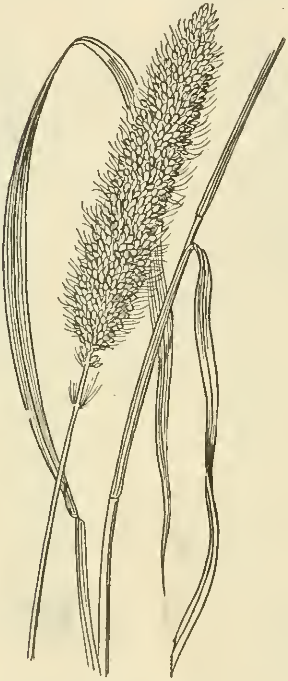


Fig. 29.—German Millet.

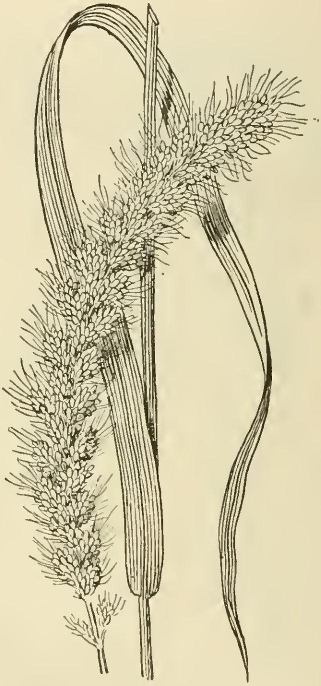


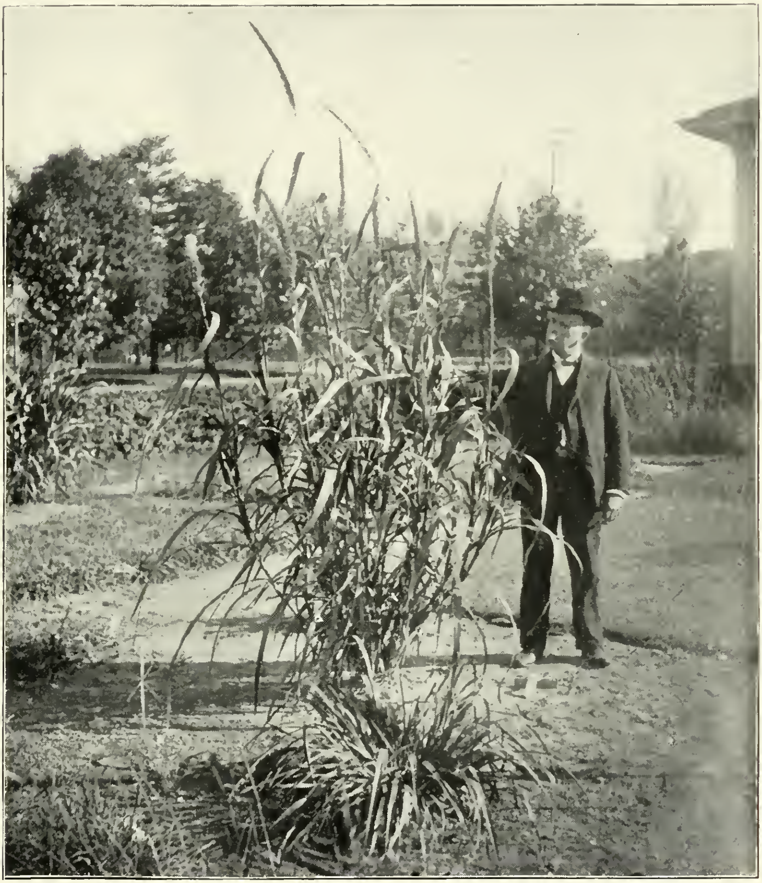
Fig. 30.—Millet (*Chætochloa italica*).

No. 72. Chætochloa verticillata (Linn.) Scribn. Bristly Foxtail.

Has about the same wide distribution as *Chætochloa glauca*, but is much less common in the United States. It is rarely found except in waste town lots and about dwellings in the Atlantic States. The bristles in this species are barbed downward, on account of which the "heads" cling to clothing or other objects with which they may come in contact. A weed.

No. 73. Chætochloa viridis (Linn.) Scribn. Green Foxtail.

Similar in habit to *Chætochloa glauca*, with about the same distribution, and equally common in this country, appearing as a weed in all cultivated grounds. It



SINGLE PLANT OF NATIVE "GIANT MILLET" IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

begins to bloom a little earlier than the Yellow Foxtail, the more numerous spikelets are smaller, the head or panicle less erect, and the bristles usually green, not yellow, as in that species. The stems are very tough and may be utilized for making paper.

No. 74. Chloris barbata Sw. Bearded Crowfoot.

This and the very similar *C. elegans* of our Southwestern States and Territories are pleasing ornamental grasses, growing to the height of 1 to 2 feet, the main stem and branches being terminated by 3 to 10 bearded spikes, which impart to them a striking appearance and make them valuable ornamentals. *C. polydactyla*, a West Indian species which has been found in southern Florida, is equally attractive, and has longer and more graceful spikes. *C. barbata* appears to be the only one generally cultivated, but there are several native species which are quite as ornamental. *C. gracilis*, a native of Central America and Mexico, is another species occasionally cultivated for ornament.

No. 75. Chloris glauca (Chapm.) Vasey. Smooth Chloris. (Fig. 31.)

A strong-growing grass, with diffusely spreading and ascending stems, 2 to 4 feet long, bearing 10 to 25 slender terminal spikes. Native of Florida, growing on brackish marshes and along the borders of cypress swamps. This is a handsome species, well deserving the attention of the florist and although not at present recognized as possessing any agricultural value, it produces a large amount of comparatively tender herbage and may prove to be a desirable fodder plant for certain localities along the Gulf coast. It has made a good growth under cultivation on clayey soil at Washington, D. C.

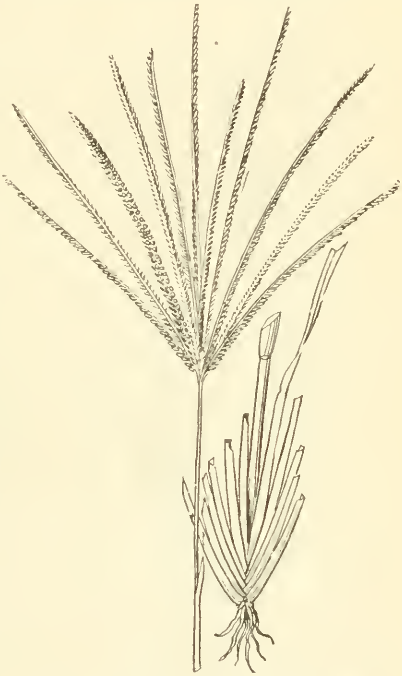


FIG. 31.—Smooth Chloris (*Chloris glauca*).

No. 76. Chloris verticillata Nutt. Windmill-grass.

A low, spreading perennial, with upright flowering branches 6 to 20 inches high. The small awned spikelets are in slender spikes, which are crowded near the apex of the stems, and become widely-spreading at maturity. This grass is common in many places in central Texas, New Mexico, Arizona, northward to Kansas, and by some is spoken of very highly as an excellent grass for grazing, and one not easily tramped out. The arrangement of the spikes gives the grass an odd and somewhat pleasing appearance, making it of some use as an ornamental species for gardens. It is a good turf-former.

No. 77. Cinna arundinacea Linn. Indian Reed.

A tall, leafy grass, 3 to 7 feet high, native and frequent in shaded swamps and damp woods or along streams in wet meadows. For such places it may possess some agricultural value, as it yields a large amount of excellent hay where growing abundantly.

No. 78. Coix lacryma-jobi Linn. Job's Tears.

This grass is a native of southern Asia, and is occasionally cultivated in this country for ornament or as a curiosity. It is cultivated for food by some of the hill tribes of India, and supplies a staple article of diet of the Tankhul Nagas of Manipur. The female flowers of this grass are inclosed in a nearly globular, capsule-like covering, which is very hard and becomes nearly white with age. In some countries these capsules are used for dress ornamentation and by the Catholics for rosaries. In China this grass is cultivated to some extent, because the fruit is believed to be valuable as a diuretic and antiphthisis. It is a hardy annual, 2 to 3 feet high, with broad leaves and a curious, nodding inflorescence. The "seeds" may be obtained from any of the leading seedsmen.

No. 79. Cynodon dactylon Pers. Bermuda-grass. (Fig. 32.)

A grass widely dispersed over the tropical regions and warmer countries of the globe. It has a creeping habit of growth. extending over the surface of the ground and rooting at the joints. In poor soils the leaves are short and the upright flowering stems are only a few inches high, but on good land it grows to the height of 1 to 2 feet and yields a large amount of excellent hay. It may be cut three or four times during the season. In the Northern States it does not afford a profitable crop and is of little value for pasturage north of Virginia, but in the Southern States and in the warmer regions of the Southwest and on the Pacific slope it is cultivated extensively and is most highly prized, chiefly for grazing, all kinds of stock being exceedingly fond of it. It grows freely on sandy soils where other grasses will not thrive, and resists extreme drought and high temperatures. It is particularly a sun-loving grass, and will not thrive in the shade. It is useful for binding drifting sands and the loose soil of embankments or those subject to wash. It makes a pleasing lawn grass, and is extensively used for this purpose in the hotter portions of the United States, for it will thrive where the grasses ordinarily employed for lawns could not survive. The yield of hay under good conditions is from 3 to 4 tons to the acre, and as high as 10 tons to the acre have been produced under peculiarly favorable circumstances. While this grass will survive the winters of the latitude of Philadelphia, the leafage is very sensitive to cold and turns brown with the first frosts. This fact renders it objectionable as a lawn grass, except in regions where the winter season is very mild. In many portions of the Southern States there is probably no grass equal to Bermuda for summer pastures, and none which will better resist the trampling of stock. Bermuda does not mature seed except in the extreme southern portion of our country, but seed obtained from more southern latitudes is offered for sale by some of our leading seed dealers. The most direct and certain method of propagation is by transplanting, which may be effected by cutting up Bermuda turf into small pieces, scattering these along shallow furrows and covering them lightly. When once established, Bermuda grass is very persistent and difficult to eradicate, and it should not be introduced upon land which is likely to be used for other crops. New York catalogues quote the seed at $1 to $1.25 per pound, retail. In the vicinity of

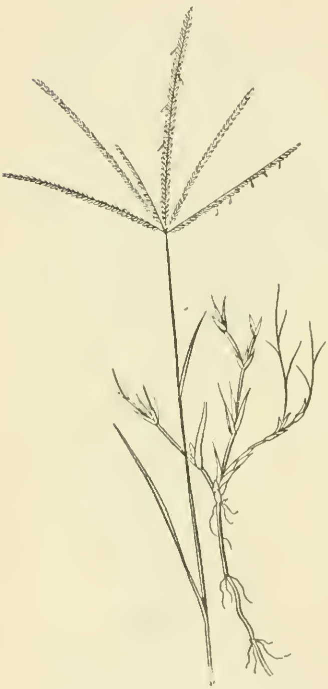


FIG. 32.—Bermuda-grass (*Cynodon dactylon*).

Washington, D. C., Bermuda-grass is known as wire grass, and in Australia it is called Couch-grass.

No. 80. Cynosurus cristatus Linn. Crested Dog's-tail. (Fig. 33).

A slightly tufted perennial grass, 1 to 2 feet high, with fine and chiefly radical leaves. It is a native of Europe and is adapted to cultivation in moist, temperate regions, and has been sparingly introduced into this country. On moist, rich land it is fairly productive, but is rarely sown alone, excepting for seed or the formation of lawns, for which latter purpose it is well adapted, as it forms an even and compact sward when thickly sown. It is said to thrive well in the shade, a fact which gives it importance to those having shaded lawns. It forms a good bottom grass, has a highly nutritive value, and is recommended for all mixtures used for permanent pastures, especially in hilly regions. The mature stems of this grass are among the most valuable of those used in the manufacture of Leghorn hats. Number of seeds in a pound of pure seed is about 1,127,000. Price of seed in New York, 40 to 60 cents per pound, or $7 to $12 per bushel of 21 pounds.

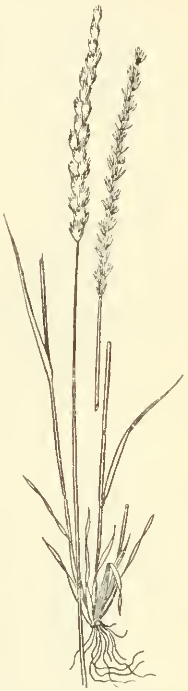


Fig. 33.—Crested Dog's-tail (*Cynosurus cristatus.*)

No. 81. Dactylis glomerata Linn. Orchard-grass. (Fig. 34.)

This is one of the best known and most popular of our cultivated grasses. It will grow well on any soil containing a reasonable amount of fertility, excepting that which is very wet. It is a hardy grass and may be grown successfully anywhere in the United States, except in the extreme South and in the arid regions of the West. It yields an abundant crop of excellent hay, and may be sown alone for this purpose, but owing to its habit of forming tufts or tussocks, the land should be seeded heavily or the seeds should be mixed with other kinds, to act as fillers or bottom grasses. It is a good pasture grass, especially for open woodlands, and affords excellent grazing earlier than almost any other species. The aftermath is unequaled in amount by any of the grasses ordinarily cultivated for hay. When sown with other grasses, the tendency of Orchard-grass to form tussocks is much diminished and the sward greatly improved. Heavy rolling is also recommended for checking or preventing the tufted growth which this grass naturally assumes. By this operation the tufts are pressed down to the level of the other grasses and the turf becomes more uniform. In old, rich meadows of Orchard-grass it is advisable to harrow in the spring and afterwards use the roller. Its best record of yield, made by Sinclair, was 27,905 pounds green, 11,859 pounds of hay, and 11,910 pounds of green aftermath per acre. Sow 3 to 4 bushels to the acre. The average number of grains in one pound of pure seed is 579,500. Price of seed, as given in New York catalogues, $3 per bushel of 14 pounds. In England Orchard-grass is known as Cock's-foot.

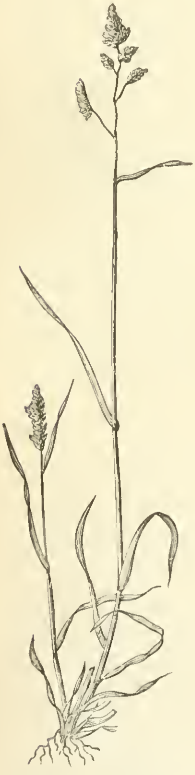


Fig. 34.—Orchard-grass (*Dactylis glomerata*).

No. 82. Dactyloctenium aegyptium (Linn.) Willd. Crowfoot-grass. (Fig. 35.)

This grass, which is a weed throughout all the warmer countries of the world, has become quite common in some of the Southern States. It closely resembles the more common Goose-grass or Duck's-grass (*Eleusine indica*), from which it differs chiefly in having the terminal spikes shorter and each tipped with a sharp prolongation of the axis. It is usually found in cultivated fields, and often in such abundance as to displace the less vigorous native sorts, and is sometimes cut for hay. In parts of Africa, where this grass is common, a decoction is prepared from the seeds, which is used for inflammation of the kidneys. In Australia it is valued for pasture. In India the grain is sometimes used for food by the natives in times of scarcity. The Mohave Indians of California also use the grain for food, grinding it and making the flour into cakes or mush. (C. R. Orcutt.)

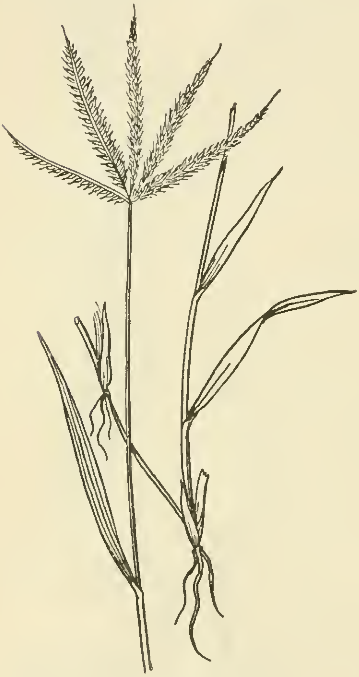


Fig. 35.—Crowfoot-grass (*Dactyloctenium ægyptium*).

No. 83. Danthonia compressa Austin. Tennessee Oat-grass.

A slender, erect, tufted perennial, usually growing to the height of about 2 feet, with long and narrow root-leaves, and few-flowered spreading panicles. It is a common grass in the hilly regions of New England and the Middle States, and extends southward into North Carolina and Tennessee along the mountains, where it forms the bulk of the forage of the so-called "balds" or parks which are common to mountains in the South. It is highly nutritious, as determined by chemical analysis, as well as by its effect upon the stock grazing upon it. It stands well the trampling and grazing of both horses and cattle, but sheep are too close feeders, and where these range it soon disappears.

No. 84. Deschampsia cæspitosa (L.) Beauv. Tufted Hair-grass.

A native perennial, ranging from New England to Pennsylvania, and westward to the Pacific Coast. It yields an inferior, coarse, harsh forage, and is not eaten by stock except when young. It has a record of producing 10,209 pounds green and 3,318 pounds dry hay per acre. Johnson, in his work on British grasses, says of the tendency of Tufted Hair-grass to form tussocks: "In the economy of nature these tufts, so unsightly and disfiguring to the landscape, are valuable by contributing to elevate and solidify low lands liable to be overflowed by rivers, and where they occur on hill and mountain slopes, by binding the spongy soil and preventing the slips which would leave them bare." This grass is most abundant in the Rocky Mountain region, where it doubtless serves to a considerable extent the purpose here mentioned. In England it is sometimes used by the farmers to make door mats. In Germany it furnishes the "Lyme-grass" used in upholstery. Price of the seed in New York, $22 per 100 pounds.

No. 85. Deschampsia flexuosa (L.) Trin. Wood-Hair grass. (Fig. 36.)

A slender perennial grass, 1 to 2 feet high, with numerous very fine root-leaves and a delicate capillary panicle. It grows in tufts like *Deschampsia cæspitosa*, and is more common in the Eastern States than that species, but is even less valuable for meadows. It is, however, of some value for woodland pastures, as it will grow very well in the shade. It extends southward along the mountains into North Carolina and Tennessee. Its range westward is limited. It has a record of producing 12,209 pounds of rowen and 3,318 of dry hay per acre. The price of seed quoted in New York catalogues is $15 per 100 pounds.

No. 86. Distichlis spicata (L.) Greene. Salt-grass. (Fig. 37.)

An upright, wiry grass, 10 to 20 inches high, with strong, extensively creeping rootstocks. Common along the coast on both sides of the continent, and abundant in the alkaline regions of the interior, where it is often found covering considerable areas to the exclusion of other grasses. It thrives even in ground heavily crusted with alkali and other salts sufficient to destroy almost any other kind of vegetable growth. Prospectors and miners consider its presence a sure sign of water near the surface, and when crossing the desert select spots where it grows to dig for water (Orcutt). In farming lands it is deemed a nuisance, for its tough, matted roots make a sod almost impossible to break up with a plow. Although sometimes eaten by stock in the absence of better sorts, it has little agricultural value. It is a good grass for binding loose sands or soils subject to wash.

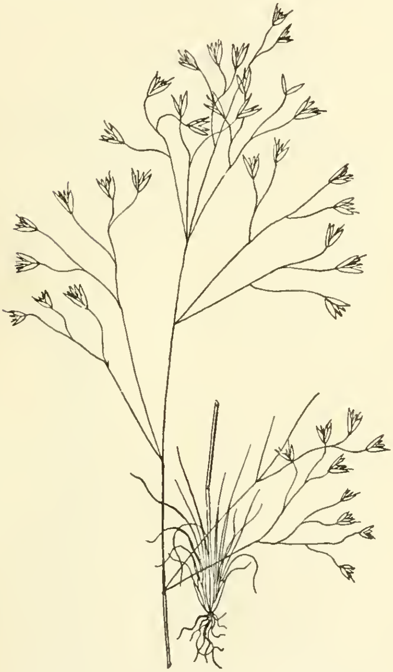


Fig. 36.—Wood Hair-grass (*Deschampsia flexuosa*).

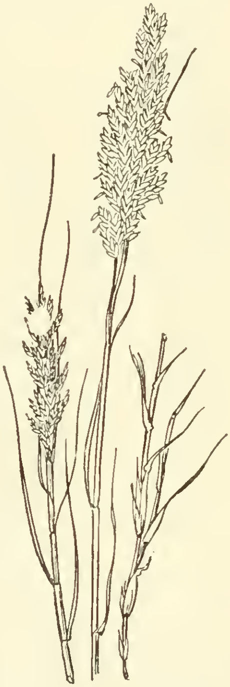


Fig. 37.—Salt-grass (*Distichlis spicata*).

No. 87. Eatonia obtusata (Michx.) Gray. Early Bunch-grass.

A tufted perennial, 1 to 2 feet high, with flat leaves and rather densely flowered nodding panicles. This is a native species, growing usually in moist soil, and ranging from New York to California and southward. A tender grass, readily eaten by stock, which, when abundant, supplies considerable native forage of good quality.

No. 88. Eleusine coracana (L.) Gærtn. African Millet.

An erect annual grass, 2 to 4 feet high, closely related to and much resembling our common crowfoot (*Eleusine indica*), but of rather stouter habit and with larger spikes and seeds. It is cultivated in India, southern China, Japan, and in many parts of Africa for the grain, which is used as food. It forms the principal food of many African tribes. In spite of the bitter taste of the flour, a kind of bread or unleavened cake is made of it. Beer is brewed from the grain in Abyssinia. Said to yield good crops, even on very poor soil, and may be cultivated in the same way and for the same purposes as millet. The seeds are marked with very fine, comb-like lines.

No. 89. Eleusine indica (Linn.) Gærtn. Goose-grass. (Fig. 38.)

A coarse, tufted annual, with erect or spreading stems, 6 inches to 2 feet high; spikelets arranged in a number of spikes which are clustered at the top of the stem. This grass is distributed throughout the warmer countries of the globe, and is particularly abundant in the Southern States, growing in cultivated grounds about dwellings, etc. It has somewhat wiry, flattened stems, many springing from a single root, and rather thick leaves. Some authors have spoken of it as being nutritious and good for grazing or soiling and for hay, but it is more generally regarded as a weed, and often a troublesome one in dooryards or lawns.

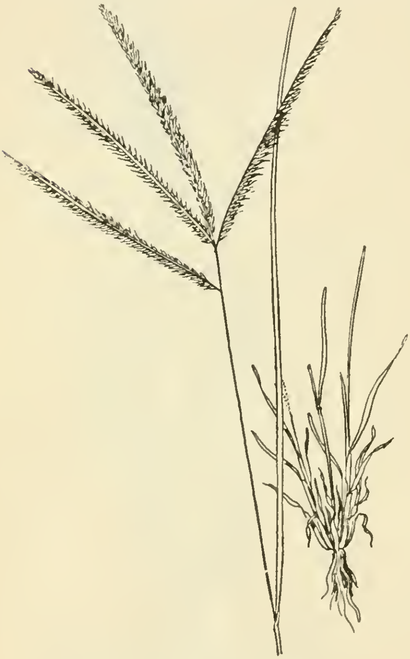


FIG. 38.—Goose-grass (*Eleusine indica*).

No. 90. Elymus arenarius Linn. Sea Lyme-grass. (Fig. 39.)

A stout, coarse grass, 2 to 8 feet high, with strong, creeping rootstocks, smooth stems, long, rigid leaves, and dense terminal spikes 6 to 12 inches long. The spikelets are about an inch long and three- to four-flowered. This grass is common along the seacoast of northern Europe, our north Atlantic coast, and on our Western shores from Santa Cruz, Cal., northward to within the Arctic zone. It is one of the best grasses known for binding the drifting sands of the coast, and in northern Europe has been cultivated along with Beach-grass for this purpose. These two grasses when combined seem admirably adapted for the purpose of forming a barrier to the encroachment of the sea; the sand that Beach-grass arrests and collects about itself the Lyme-grass secures and holds fast. The seeds are used for food by the Digger Indians of the Northwest, and as the grass springs up around their deserted lodges it is called by the settlers "*Rancheria*" grass. This Lyme-grass is usually regarded as possessing little or no forage value, but in very moist climates or under certain favorable conditions it may yield a valuable fodder, for when young the grass is tender and nutritious.

No. 91. Elymus canadensis Linn. Wild Rye.

A rather stout, smooth perennial, 3 to 5 feet high, with broad, flat leaves, 6 to 12 inches long. The bearded spikelets are arranged in a terminal spike or "head," which has some resemblance to a head of rye. Common in low thickets and along streams in rich, open woods throughout the country. In the Northwest it is regarded as of some agricultural value; its cultivation is evidently worthy of trial, for if it could be successfully grown its yield of hay would be large, and, judging from appearances, the hay would be of good quality.

No. 92. Elymus condensatus Presl. Giant Rye-grass.

The largest of the native Rye-grasses, growing to the height of 5 to 10 feet. Common in the Rocky Mountain regions and on the Pacific slope, usually growing along rivers or streams the banks of which are protected and held together by the strong, spreading rootstocks of the grass. This grass is useful for holding the sand on railway banks, etc. When young this grass makes excellent hay, and when allowed to stand it affords a considerable amount of fodder for stock on the winter ranges. The seeds are used for food by the Indians.

No. 93. Elymus macounii Vasey. Macoun's Rye-grass.

A perennial grass, found quite abundantly in moist meadows, in the gravelly foothills of the northern Rocky Mountains. The culms are leafy, and this grass contributes quite largely to the native hay cut by the ranchers of the Northwest. It is apparently a very valuable species.

No. 94. Elymus mollis Trin. Soft Sea Lyme-grass.

A grass which closely resembles and has the same habit of growth as *Elymus arenarius*. It is distinguished by having the stem soft-downy just below the head or spike and in having five to seven flowered spikelets, the outer glumes of which are broader and five- to seven-nerved. This grass occurs along the shores of the Great Lakes and northward on both the Atlantic and Pacific coasts.

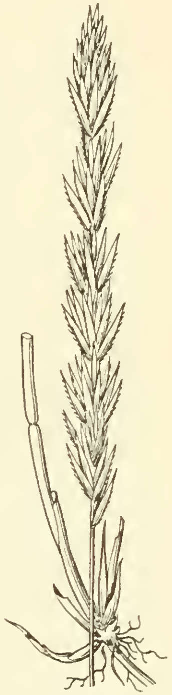


Fig. 39.—Sea Lyme-grass (*Elymus arenarius*).

No. 95. Elymus triticoides Nutt. Wild Wheat.

By some this has been regarded as a small, reduced form of *Elymus condensatus*, mentioned above. It grows to the height of 2 to 3 or 4 feet and is native of the Rocky Mountain region and Pacific Slope, extending eastward nearly to the Mississippi. While it is a grass of good appearance and possibly of some agricultural value, no attempts have been made to cultivate it.

No. 96. Elymus virginicus Linn. Terrell-grass. (Fig. 40.)

The most common of our native species of Lyme-grass, growing along streams, the borders of woods and thickets, more rarely in the open ground. It is an erect, smooth grass, 2 to 3 feet high, with rigid terminal spikes, which are often partly included within the upper leaf-sheath. This grass has the appearance of possessing some agricultural value; it forms an inferior turf, and by the time it blooms all the lower leaves are usually dead. When young it doubtless possesses some value as a native pasture grass. In Kansas, South Dakota, and Nebraska it is regarded a valuable grass for woodland pastures.

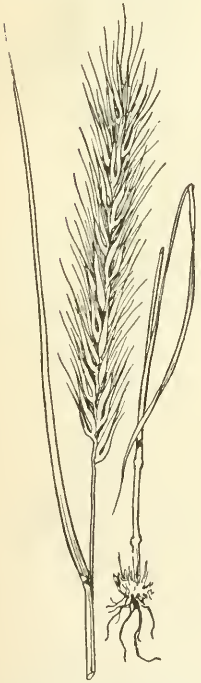


Fig. 40. — Terrell-grass (*Elymus virginicus*).

No. 97. Epicampes rigens Benth. Deer-grass. (Fig. 41.)

A stout, erect grass, 3 to 4 feet high, with rigid, wiry stems, and a very long, narrow, densely flowered, spike-like panicle. This grass is not uncommon in Arizona, southern California, and New Mexico, growing in sandy soil. It is regarded as one of the best native dry land grasses, and is closely grazed wherever stock can get at it. The roots of *Epicampes macroura* — Mexican Broom-root or Mexican Whisk—are used in making brushes and are exported from Vera Cruz to Europe for this purpose.

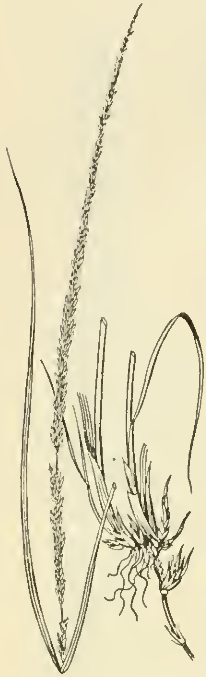


Fig. 41.—Deer-grass (*Epicampes rigens*).

No. 98. Eragrostis abyssinica Link. Teff.

A branching, leafy annual, 2 to 4 feet high, with widely spreading capillary panicles of many spikelets. This grass grows readily from seed, which is produced abundantly, and it may be of some value for hay in parts of the South or Southwest. In northeastern Africa, where the grass is apparently native, the grain is extensively used for food, being made into bread, which possesses a slight but agreeable acid taste. There are two varieties cultivated, a white and a red variety, the former being much superior to the latter and used only by the higher classes. It is sometimes grown in gardens for the elegant panicles, which are used in bouquets. *Eragrostis neomexicana* Vasey, with the general habit of growth of Teff, occurs in New Mexico, springing up after rains, particularly in the region about Deming, where it is called "Crab-grass." It is an annual, growing to the height of 2 to 4 feet, with widely spreading, many flowered panicles, and is largely cut for hay.

No. 99. Eragrostis major Host. Stink-grass. (Fig. 42.)

A rather showy, much-branched annual, with erect or ascending stems, 6 inches to 2 or 3 feet high. This species, which is a native of Europe, has become widely distributed in this country, growing chiefly in cultivated or waste grounds, especially in light soils. When fresh it emits a strong, unpleasant odor.

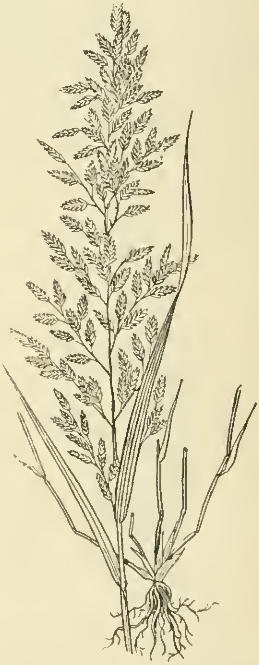


Fig. 42.—Stink-grass (*Eragrostis major*).

No. 100. Eragrostis obtusiflora (Fourn.) Scribn. Mexican Salt-grass.

A rigid perennial, 12 to 18 inches high, with strong and extensively scaly rootstocks, stiff and sharp-pointed leaves, and more or less spreading panicles. Abundant in the highly alkaline soils of Sulphur Springs Valley, Arizona, where the large rootstocks serve to bind the shifting sands. In the absence of other grasses it is eaten by stock.

No. 101. Eragrostis pilosa (Linn.) Beauv. Slender Meadow-grass.

A slender branching annual, 6 to 18 inches high, with narrow, flat leaves and capillary, open panicles. This grass is widely distributed throughout the subtropical and warmer temperate regions of both hemispheres. In this country it has received no attention or is regarded as little more than a weed, but in Australia and India it is spoken of as being an excellent fodder grass, and the seeds are eaten by the natives of Ajmere, India.

No. 102. Eragrostis purshii Schrad. Southern Spear-grass.

A native annual, similar in appearance to *Eragrostis pilosa*, and growing in similar situations. It is common from the Middle States southward, and extends southwestward into Texas and Arizona, where it exists in a great variety of forms. It grows to the height of 1 to 2 feet. It is nowhere considered of any agricultural importance.

No. 103. Erianthus ravennæ Beauv. Plume-grass.

A stout grass growing to the height of 8 or 10 feet, with large and plume-like panicles 10 to 20 inches long, resembling in some degree Pampas-grass. Cultivated for lawn decoration, as is also the variety with variegated leaves. A native of the Mediterranean region.

No. 104. Erianthus saccharoides Michx. Plume-grass.

A tall stout grass of striking appearance, 4 to 6 feet high, with a reddish or silvery-white showy panicle from 5 to 10 inches long. This grass ranges from New Jersey to Illinois and southward to the Gulf, growing in very wet places and open swamps. Of no agricultural value, but deserves notice as an ornamental grass for lawns and gardens.

No. 105. Eriochloa aristata Vasey. Mexican Everlasting-grass.

A branching leafy annual, 2 to 3 feet high; native of Mexico. Seed of this grass was obtained by the Department in 1888. It was cultivated in the grass garden located at Starkville, Miss., by Prof. S. M. Tracy, who says that it is a much more promising grass than *E. annulata*, more hardy, less injured by drought, and produces a heavier growth. It will make two good crops of hay annually in the South, the best crop being from the second growth, which is ready to cut in October. The grass produces an abundance of seed and reseeds itself, making its production comparatively inexpensive.

No. 106. Eriochloa punctata (Linn.) Hamilt. Everlasting-grass.

A quick-growing, smooth, succulent perennial, 2 to 3 feet high, with flat leaves and narrow panicles 2 to 4 inches long. Widely distributed within the tropical and subtropical regions of both hemispheres. In Australia it is regarded as an excellent pasture grass, lasting all the year round and well liked by stock. The seed, which is produced abundantly, is easily gathered. This grass deserves the attention of Southern dairymen. In Arizona it grows throughout the valleys in irrigated soil, or in the rich moist places of the plains, yielding abundant herbage eagerly sought by all kinds of stock.

No. 107. Eriocoma cuspidata Nutt. Indian Millet. (Fig. 43.)

A grass of rather striking appearance, 1 to 2 feet high, widely distributed throughout the Rocky Mountain region from British America southward to Texas and New Mexico, eastward to the Missouri, and westward to the Sierras of California. It grows in dry sandy soils, forming bunches of greater or less size, and from this habit of growth it has been called, along with a number of other grasses, "Bunch-grass." It thrives in soil too dry and sandy for the growth of most other grasses, and is much esteemed for grazing in the regions where it abounds. In New Mexico this grass is by some deemed superior to grama, on account of its large and nutritious seeds or grains, which are used by the Indians to some extent for food.

No. 108. Euchlæna mexicana Schrad. Teosinte. (Fig. 44.)

A stout, leafy, annual grass, 8 to 10 or 12 feet high, resembling Indian corn, to which it is botanically closely related. The variety *E. luxurians,* of the seed catalogues, which has been cultivated in various parts of the South and West, has a habit of tillering, or sending up many—20 to 50—stalks from the same root (Plate III, fig. 1). From this habit the bulk of fodder produced to the acre is very large, probably unequaled by any other grass. It is liked by all kinds of stock, and has especial value as a green fodder when other forage is dried up. It may be cut several times during the season, but nearly as good results will be obtained from a single cutting, made before there is any frost. The stalks are tender, and there is no waste in the fodder when dry or green. One pound of seed to the acre, planted in drills 3 feet apart and thinned to a foot apart in the drill, is recommended. It is a native of the warmer portions of Mexico and Central America. The seed rarely matures north of southern Florida.

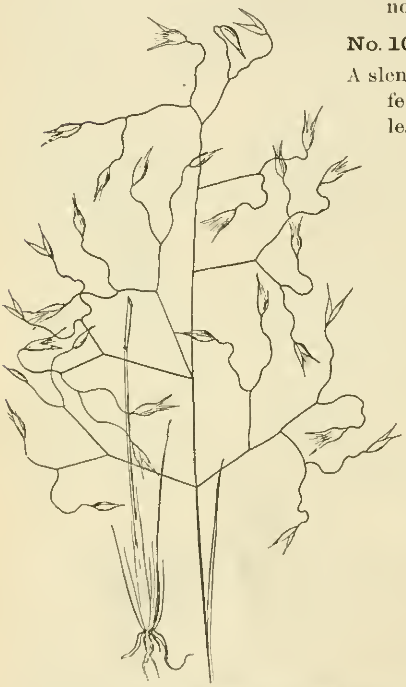


FIG. 43.—Indian Millet (*Eriocoma cuspidata*).

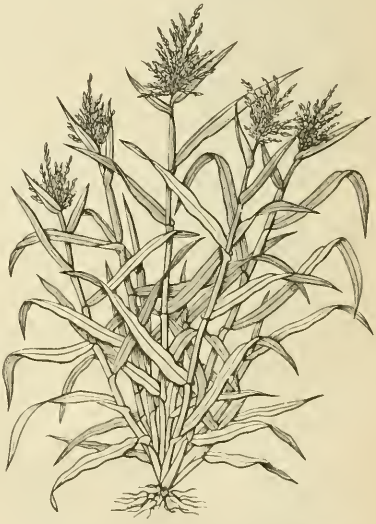


FIG. 44.—Teosinte (*Euchlæna mexicana*).

No. 109. Festuca duriuscula Lam. Hard Fescue.

A slender, densely tufted, perennial grass, 1 to 2 feet high, with numerous very fine radical leaves and open panicles. This is one of the forms of Sheep's Fescue, and is of little value except in pastures. Its particular merit lies in its ability to thrive on dry sandy soils unfit for the growth of better grasses, and it well resists long periods of summer drought. It is well adapted to the cooler and mountainous regions of our country, being a native of the cooler temperate regions of both hemispheres. On well-manured, clayey land this Fescue has produced upon a single acre 18,376 pounds of green hay at time of flowering, and 8,269 pounds of hay besides 10,029 pounds of aftermath. It possesses some value as a lawn grass, but if used for this purpose it should be sown thickly and unmixed with other sorts. Sow 2½ to 3 bushels to the acre. Price of seed in New York market, $16 to $18 per 100 pounds.

No. 110. Festuca elatior Linn. Tall, or Meadow Fescue.

This grass has been widely cultivated in this country, having been introduced from Europe, and has become thoroughly naturalized. It is an exceedingly valuable

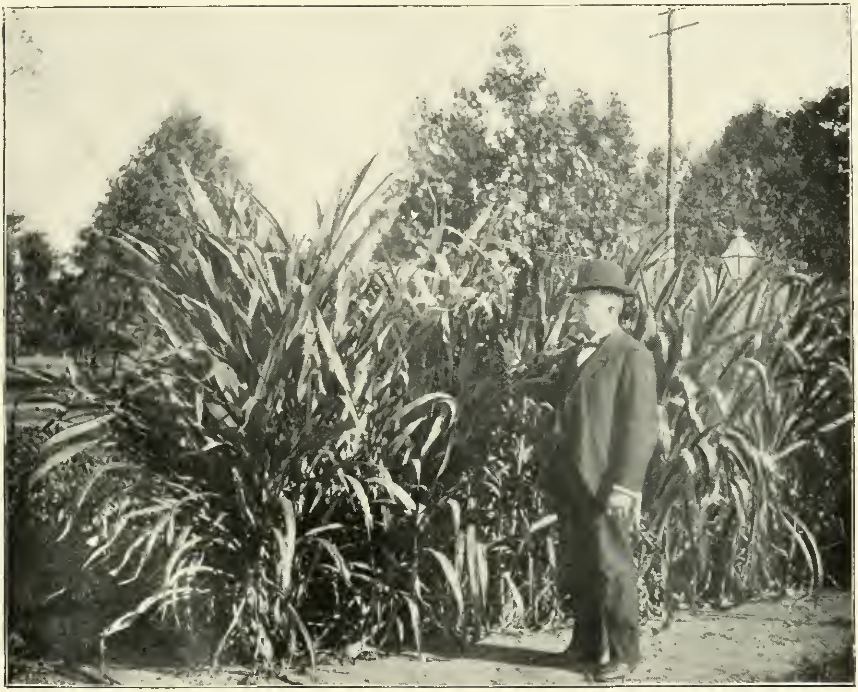


FIG. 1.—YOUNG PLANTS OF TEOSINTE IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

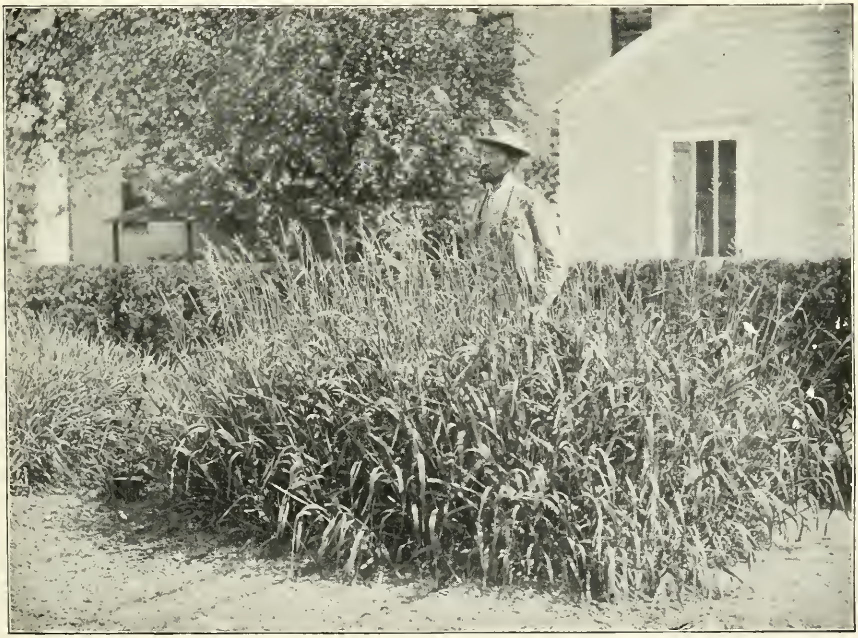


FIG. 2.—REED CANARY GRASS IN GRASS GARDEN OF THE U. S. DEPARTMENT OF AGRICULTURE.

grass either for mowing or pasture. It is productive on soils which are not too dry, and, being of long duration, is especially valuable for permanent pastures. It thrives best on moist soils rich in humus, whether marls or clays. The variety *pratensis*, or Meadow Fescue, is a common form, rather smaller than the species, with a narrower and fewer-flowered panicle. Variety *arundinacea*, or Reed Fescue (fig. 45), is a very vigorous, tall form, 3 to 4 feet high, exceedingly hardy, and yields a very large amount of hay of excellent quality, succeeding best on lands that are comparatively moist. The seed of Meadow Fescue is quoted in some of the New York catalogues at $3.50 per bushel or $22 per 100 pounds. A bushel weighs about 14 pounds.

No. 111. Festuca heterophylla Lam. Various-leafed Fescue.

A rather slender European grass, 2 to 4 feet high, with very narrow (setaceous) root-leaves, and narrow but flat culm leaves. It is a perennial, closely related to Creeping Fescue, of which it has been made a variety by some authors. The panicle is comparatively large, open and nodding at the apex. It is a species preferring a rather mild climate, and grows naturally in open woodlands or along their borders. It makes its best growth on low-lying lands which are not too dry, but upon good soil it withstands protracted periods of drought very well. Owing to the great production of fine root leaves, this species makes a good bottom grass, and as these leaves are quite soft the grass is well adapted for lawns, and is particularly recommended for those which are too much shaded for the successful growth of other lawn grasses. It is an excellent grass, also, for woodland parks where the soil is not sandy. European authorities have classed it with the best forage plants. It is little known in this country, but the seed is offered for sale by our leading seedsmen, the retail price being from $2.75 to $3 per bushel of about 14 pounds.

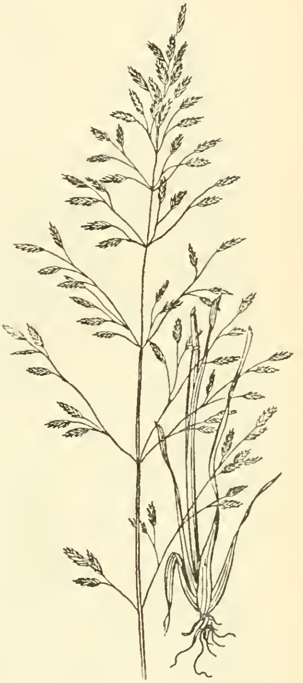


FIG. 45.—Reed Fescue (*Festuca elatior arundinacea*).

No. 112. Festuca kingii (S. Wats.) Scribn. King's Fescue.

A tall diœcious bunch grass, common in the foothills and canyons of Colorado and Montana. It is a very robust species, and supplies a large amount of good though coarse winter forage. Growing naturally at an elevation of 7,000 to 8,000 feet, it might prove valuable in cultivation in similar localities.

No. 113. Festuca ovina Linn. Sheep's Fescue.

Sheep's Fescue exists in many varieties in the Northwestern States, especially in the Rocky Mountain region. Some of these varieties attain the height of 2 or 3 feet, but for the most part they are rarely more than a foot high, producing a large amount of fine herbage, which is valuable for grazing, especially for sheep. Some of the native varieties are well worthy the attention of the agriculturist. All the forms of *Festuca ovina* are "bunch-grasses," and are devoid of the creeping roots, the presence of which distinguishes the Red Fescue (*Festuca rubra*) from this species. Sheep's Fescue is well adapted for cultivation on light, dry soils, especially those which are shallow and silicious. Although a native of this country, our seed supply comes mostly, if not entirely, from Europe, where the grass is also native. Sow $2\frac{1}{2}$ to 3 bushels per acre. The weight of a bushel of seed is about 14 pounds. Price per bushel, \$2.25 to \$2.75 in New York.

No. 114. Festuca rubra Linn. Red Fescue.

This grass grows along the Atlantic coast of the New England and Middle States, and in the Northern States, extending westward to the Pacific. Like *Festuca ovina*, it presents many forms, but in some respects is superior to that species, as by its creeping rhizomes it will form a compact and durable turf. On account of this habit of growth, it is a useful grass for binding moving sands along the seacoast, or covering gravelly banks and dry slopes. In Germany, Red Fescue is regarded as one of the most valuable grasses for dry, sandy meadows. Owing to the great production of fine root leaves, this species makes a good bottom grass, and as these leaves are quite soft the grass is well adapted for lawns, and is particularly recommended for those which are too much shaded for the successful growth of other lawn grasses. It is an excellent grass also for woodland parks where the soil is not sandy. European authorities have classed it with the best forage plants. It is little known in this country, but the seed is offered for sale by our leading seedsmen, the retail price being from \$2.50 to \$3 per bushel of about 14 pounds. A variety, *F. rubra glaucescens* Hack. (fig. 46), is the best pasture grass in the mountain meadows of North Carolina and East Tennessee.

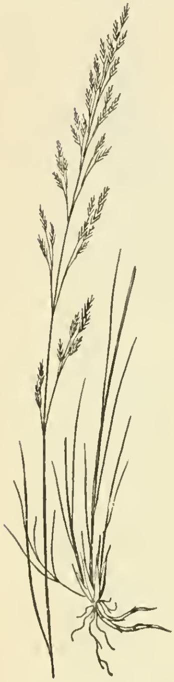


FIG. 46.—Tennessee Fescue (*Festuca rubra glaucescens*).

No. 115. Festuca scabrella Torr. Great Bunch-grass. (Fig. 47.)

A strong perennial, growing in large tufts or bunches 1 to 3 or 4 feet high. A native of the Rocky Mountain regions, extending from Colorado northward and westward to California and Oregon. It often occupies extensive mountain parks, to the exclusion of other grasses, where it affords excellent grazing. It may be cut for hay, of which it furnishes a large amount, excellent in quality, especially for horses. It is one of the best grasses for winter stock ranges. In the Northwest, particularly in the Rocky Mountain region, there are many native species of the genus *Festuca* which are well deserving the attention of stockmen and farmers.

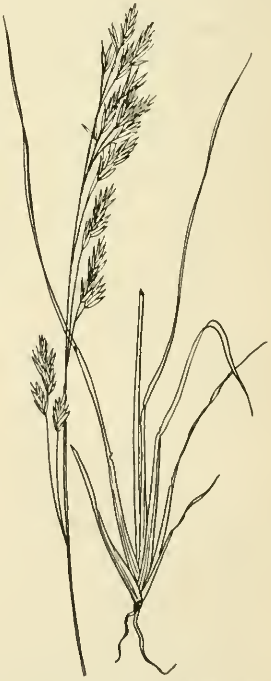


FIG. 47.—Great Bunch-grass (*Festuca scabrella*).

No. 116. Festuca tenuifolia Sibth. Slender Fescue.

A low and fine-leafed grass, in habit of growth resembling *Festuca ovina*, of which it is regarded as only a variety by most authors. It has no special agricultural value, but will grow in dry and comparatively sterile soil. Its fine, hair-like leaves and densely cespitose habit of growth render it a good lawn grass when properly treated, especially for shady places, and it is also a good plant for edgings.

No. 117. Fourniera mexicana Scribn. Mexican Lawn-grass.

A low, extensively creeping grass that grows in the mountain valleys of western Mexico. Stock eat it with avidity. An excellent lawn and pasture grass for subtropical regions.

No. 118. Gynerium argenteum Nees. Pampas-grass.

A stout perennial, 8 to 12 feet high, with mostly radical, narrow leaves 3 to 6 feet long, and showy, silvery white or rose-red panicles 15 to 30 inches long. A much-prized ornamental for lawn decoration. The handsome panicles are used for dry bouquets. Growing Pampas plumes is an important industry in some parts of California. These plumes or panicles are cut when exposed only a few inches from the leaf sheath, then dried, and done up into bundles for shipment. Pampas-grass is a native of southern Brazil and Argentina, and there the long leaves are used for paper making, and a decoction of the rhizome is used as a diuretic. *G. roseum* is a horticultural variety, with pale, rose-colored plumes. *G. variegatum* is a form with variegated leaves.

No. 119. Hilaria cenchroides HBK. Curly Mesquit. (Fig. 48.)

A delicate perennial with slender, creeping stems, the upright, leafy shoots a few inches to nearly a foot high. This is one of the most valuable of the grasses of the dry plains and mesas of the Southwest. It forms a dense, green sward, and in habit of growth closely resembles the true Buffalo-grass. It has the habit of creeping over the ground and rooting at the joints of the stems, from which spring leafy branches that in turn reach out for other places in which to take root. It makes a thick mat of leafy turf during the summer, matures on its roots, and in the fall and winter, when not rotted by late rains, affords excellent pasturage for all classes of stock. No grass stands the long dry spells to which the Southwest is periodically subject better than the Curly Mesquit. At such times it dries up and appears dead, but in a few hours after a warm rain it becomes green to the end of the smallest branches. It is best propagated by transplanting the runners. Seed is produced in abundance, but is both difficult to harvest and of rather uncertain vitality.

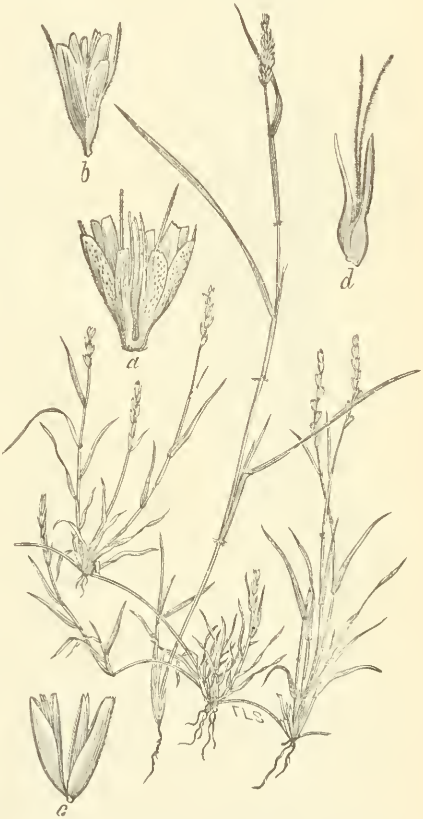


FIG. 48.—Curly Mesquit (*Hilaria cenchroides*); *a*, group of spikelets; *b*, spikelet; *c*, *d*, florets.

No. 120. Hilaria mutica Benth. Black Bunch-grass.

This is a rather coarse perennial, with creeping rootstocks, and stems 12 to 18 inches high. It is common on the dry mesas of New Mexico and Arizona, extending eastward into Texas and Indian Territory. Where abundant it is regarded as one of the most valuable native grasses and furnishes excellent pasturage at all times when not covered with snow, and is frequently cut for hay. It forms dense patches of greater or less extent on hillsides, mesas, and plains. It is also called "Black grama," and is largely gathered for hay, being uprooted with a hoe. (Pringle.)

No. 121. Hilaria rigida (Thurb.) Scribn. Galleta. (Fig. 49.)

In the driest regions of southern California and Arizona, growing in the deserts where other grasses are rarely seen. It has coarse, much-branched, and woody stems, 2 feet high or more, growing in great clumps, resembling in its habit some of the dwarf bamboos. The stems and leaf sheaths are clothed with a dense, white-matted pubescence, which gives to the grass a peculiarly striking appearance. In the regions where it grows it is regarded as valuable forage for pack animals and mules, there being little other vegetation which they can eat. Without this grass miners and prospectors would find great difficulty in traversing the arid mountain and desert regions of the Southwest, since scarcely any other forage plants occur in the districts occupied by it (Orcutt). The Hilarias, of which we have four species, are grasses peculiarly adapted for growth in the drier lands of the Southwest, and although they are, with the exception of *Hilaria cenchroides,* wiry and tough, the forage they afford is very acceptable in the absence of more succulent plants.

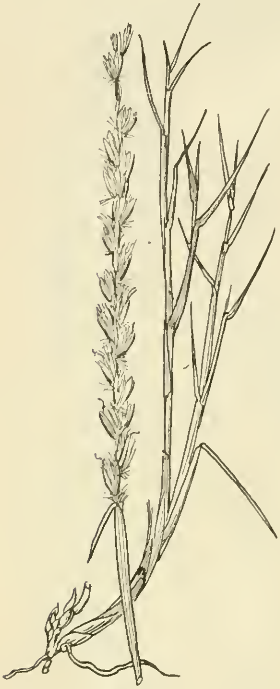


FIG. 49.—Galleta (*Hilaria rigida*).

No. 122. Holcus lanatus Linn. Velvet-grass. (Fig. 50.)

A perennial, 1 to 2 feet high, with a creeping rootstock, and stems and leaves clothed all over with a soft, whitish pubescence. This grass has been introduced into this country from Europe, and has become naturalized in many places. It possesses little nutritive value, and is not well liked by stock, particularly horses. It possesses some value, however, on peaty or sandy soils where the better grasses will not grow. Its cultivation, however, is not recommended. It is entirely unsuited for lawns.

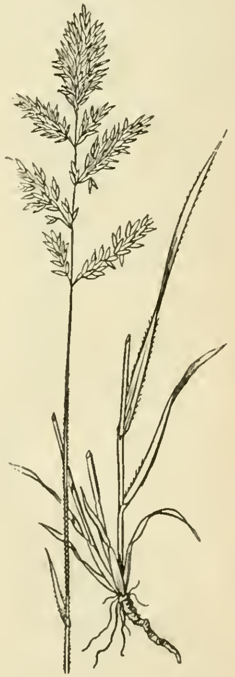


FIG. 50.—Velvet-grass (*Holcus lanatus*).

No. 123. Holcus mollis Linn. Creeping Soft-grass.

Closely allied to Velvet-grass, and said to be similarly well adapted to light, sandy forest lands. It is occasionally found in the Eastern States, the seed having been introduced with that of other grasses from Europe, as both *Holcus mollis* and *Holcus lanatus* are often used to adulterate the seeds of more expensive grasses, especially the so-called prepared mixtures of seedsmen. In Germany this grass is used on railway embankments, where on the poor, thin soil its strong, creeping roots form a turf which holds the earth together, thus preventing it from being washed or blown away.

No. 124. Hordeum jubatum Linn. Squirrel-tail-grass. (Fig. 51.)

A rather slender annual or biennial, usually about a foot high, growing along the sandy seashore, borders of the Great Lakes, and in the alkaline regions of the West. The long, slender awns of the glumes are widely spreading, and the head or spike is thus given the appearance of the "brush" of the fox, hence the common name, "foxtail." This grass is sometimes recommended for cultivation for ornament, and if the tops are cut off before the awns have expanded they may be used for dry bouquets; but the heads soon break up, and for this reason the grass is of little value even for ornament. It has no agricultural value, and, in fact, where it has spread in the West, as it often does along the irrigating ditches, it becomes a serious pest. Hay containing this squirrel-grass is considered nearly valueless. The sharp-pointed joints of the spike, each with several long and slender beards, stick fast in the nose and mouth of horses and cattle, often penetrating the flesh, and cases are reported where they have caused the death of these animals.

No. 125. Hordeum murinum Linn. Wall Barley.

A coarse, tufted annual, 6 inches to 2 feet high, with dense and somewhat flattened, bearded spikes 2 to 4 inches long The beards or barbed awns are 1 to 1½ inches long and rather rigid. This grass is a native of Europe, and has been introduced along the Pacific Coast, particularly in California, where it has become a serious pest. At maturity the head or spike readily breaks up, and the groups of spikelets, which are sharp pointed at the base, adhere to almost any passing object; they work up the nostrils of cattle and into the fleece of sheep, and may do injury to the animals in much the same way as the native *Hordeum jubatum*.

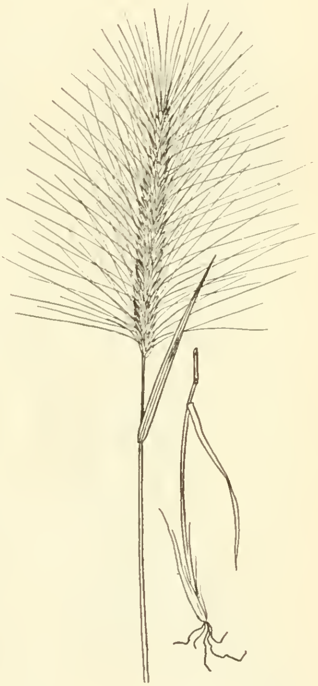


Fig. 51.—Squirrel-tail-grass (*Hordeum jubatum*).

No. 126. Hordeum sativum Jessen. Barley.

Cultivated barley presents many varieties, primarily divided into two-rowed, four-rowed, and six-rowed races. The varieties under these races are based upon the varied characters presented by the head, beards, or grain. All appear to have originated from *Hordeum spontaneum* Koch, which grows wild in the countries of southwestern Asia. Six-rowed barley has been in cultivation since prehistoric times in southern Europe; two-rowed barley is now largely cultivated in England and central Europe. The four-rowed barleys are of later origin than the others, and are most generally cultivated in northern Europe and in this country. The barley crop of the United States for 1895 was 87,072,744 bushels, of which amount six States produced over 73,000,000 bushels, California leading with 19,023,678 bushels. Barley is the most important cereal of the far north, some of the varieties being cultivated in Norway to latitude 70°. It is employed in making bread also in northern Asia and Japan. Barley soup is an article of diet in central Europe. From naked barley (*Hordeum decorticatum*) a mucilaginous tea is prepared, used in medicine. The grain is largely fed to horses, both in this country and in Europe, but the chief use is for brewing beer. "Brewers grains," a by-product, both wet and dry, are fed to cattle, chiefly in the vicinity of breweries.

No. 127. Hydrochloa carolinensis Beauv. Floating-grass.

A slender aquatic grass of the Gulf States, growing along muddy banks and in shallow streams. The stems are often 2 feet or more in length, and in shallow water their summits appear above the surface, while in water of greater depth the uppermost leaves are floating. The tender stems and leaves are eaten by stock, and may afford some food for water-fowl.

No. 128. Imperata arundinacea Cyrill. Blady-grass.

A sand and soil binder common throughout the warmer temperate and tropical regions of both hemispheres. It is a stout, erect, leafy grass, 1 to 3 feet high, with silvery-white spike-like panicles. The rootstocks form a perfect network of strong fibers, and in warm countries the grass is recommended for binding river banks, the sides of dams, and the loose sands of the coast. This grass is easily propagated by root cuttings, and might be utilized along the Gulf Coast or along the Lower Mississippi in strengthening the levees. In the Malay Archipelago this *Imperata* is the principal grass of the Alang Alang fields, and is used by the natives for thatching roofs. Cattle eat it when young with apparent relish, and in Bengal it forms a very large portion of the pasturage. The Telingas make use of it in their marriage ceremonies. In western Texas and Arizona there is a native species, *Imperata hookeri* (fig. 52), very much like the one above described, in appearance and habit of growth. It grows naturally around the borders of alkaline springs.

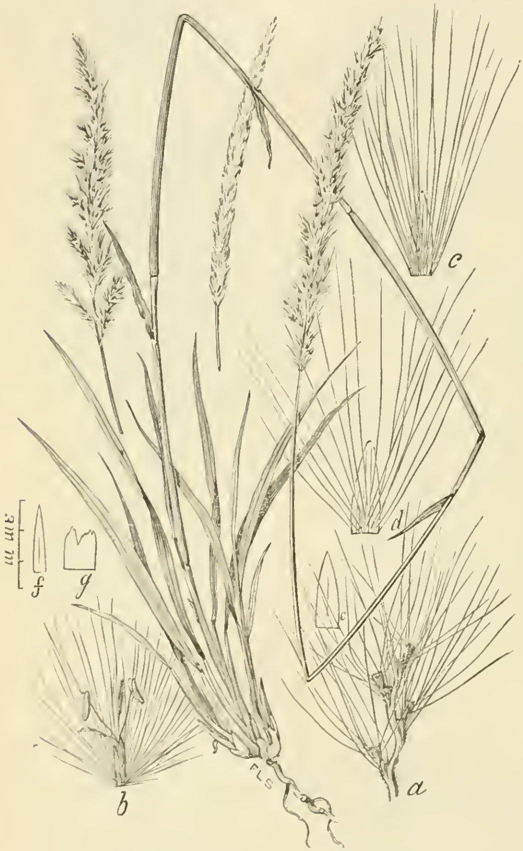


Fig. 52.—*Imperata hookeri*; *a* to *g*, details of spikelet.

No. 129. Isachne australis R. Br. Swamp Millet.

A slender grass, creeping at the base, the upright stems 1 to 2 feet high, with loose, open panicles of very small spikelets. It is a native of southern Asia and Australia, generally found growing along the sides of streams and on swampy ground. It is said to be liked by cattle, and Mr. Fred Turner recommends it for planting on the banks of rivers or dams to protect them from injury by heavy rains or floods. The underground stems and roots quickly form a perfect mat in the soil, and when once established they make a very firm turf. The grass may be propagated by seeds or pieces of the root.

No. 130. Kœleria cristata (Linn.) Pers. Prairie June-grass.

This is a common grass upon the open meadows and plains of the Central and Western States, and extends beyond the Rocky Mountains to the Pacific Coast. It is one of the "bunch-grasses" of the plains region, where it is generally associated with the more common Bunch-grass, *Poa buckleyana*. On the dry bench lands it is seldom over a foot high, but in irrigated ground grows to the height of 2 feet or more, and makes excellent hay. Its cultivation is not to be recommended where better grasses may be had. However, it possesses some value for furnishing early forage, and might be used in reseeding the native pastures.

No. 131. Lamarckia aurea Moench. Golden-top.

A low annual, 3 to 12 inches high, with flat leaves and elegant one-sided panicles 2 to 3 inches long. This very attractive and favorite ornamental grass is a native of southern Europe and southwestern Asia. It is frequently cultivated in gardens, and is a pleasing grass for edgings. It has escaped from cultivation in southern California, and has become apparently spontaneous there.

No. 132. Lolium italicum A. Br. Italian Rye-grass. (Fig. 53.)

A well-known and excellent grass for rich and rather moist lands, particularly for the Eastern States. It is a very rapid grower, forms a dense turf, and in Europe, whence the grass was introduced into this country, it is regarded as one of the best hay grasses. On stiff, heavy clays or on very dry soil it does not do well; but on good, calcareous loams or marls, or on moist, loamy sands, where the soil is in good condition, it is very productive, and no other grass repays manuring so well. It is not recommended for permanent pastures, as its duration is only two or three years, but it is a most excellent species for temporary meadows. Few grasses develop more rapidly than this, and where the soil is rich and its fertility maintained by applications of liquid manure, cuttings may be obtained within three or four weeks from seeding, and at intervals of a month or six weeks successive crops may be harvested. Owing to its succulent character and rapid growth, this makes one of the best grasses for soiling. Italian Rye-grass is at

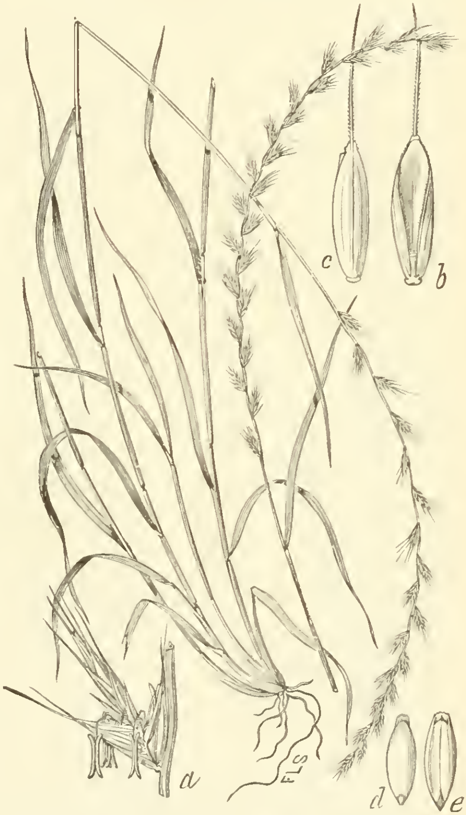


Fig. 53.—Italian Rye-grass (*Lolium italicum*): *a*. spikelet; *b*, *c*, florets; *d*, *e*, caryopsis.

once distinguished from any of the forms of perennial Rye-grass by its awned or bearded spikelets. Adulterations of the seed of Italian Rye-grass are rare, owing to its relative cheapness. The average purity of commercial seed is 95 per cent, while the germinative power is 70 per cent. The germinative power diminishes rapidly with the age of the seed. One pound of seed contains on an average 285.000 grains, and the weight per bushel varies, according to the quality, from 16 to 24 pounds. Three bushels of seed of average quality are required for sowing an acre of land. The current price in the New York market is $10 per 100 pounds.

No. 133. Lolium perenne Linn. Perennial Rye-grass.

Perennial Rye-grass has been cultivated in England for more than 200 years, and is therefore one of the oldest if not the very first grass gathered and cultivated separately for agricultural purposes. It is indigenous to Europe, North Africa, and western Asia, and was many years ago introduced into this country from England. Here it has never been so highly esteemed as in England, where the soil and climate appear to be especially well adapted to its growth. Moist and rich loams or clays are the soils best suited to it, as with Italian Rye-grass, it responds promptly to the application of quick manures. For pastures on heavy soils in moist climates it is especially valuable, and under such conditions is largely used in mixtures for permanent pastures. It is a good hay grass where the conditions are favorable, but in this country will never be so highly esteemed as Timothy. There are several varieties of perennial Rye-grass recognized by agriculturists. Pacey's Perennial, a vigorous form, is one of these. The average purity of perennial Rye-grass seed is given at 95 per cent, and the germinative power at 75 per cent. Good commercial seed should grade higher than this. One pound of pure seed contains on an average 336,800 grains. Of course, where the seeds are larger and heavier, this number would be considerably less. The best seed weighs from 25 to 35 pounds per bushel, and 2 to 3 bushels of seed are required per acre. The current retail price of good seed is $8 per 100 pounds.

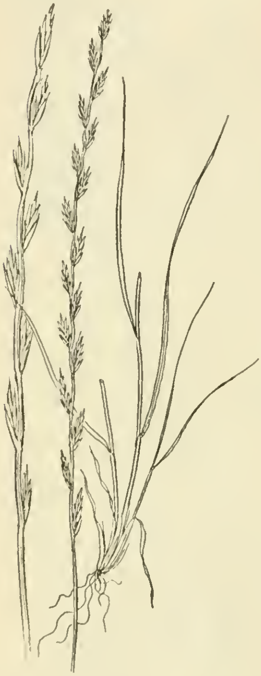


Fig. 54. — Perennial Rye-grass (*Lolium perenne*).

No. 134. Lolium temulentum Linn. Darnel.

An annual grass, 2 to 3 feet high, having a general resemblance to Italian Rye-grass, but usually stouter, more strictly erect, with longer glumes and larger seeds. It has been introduced into this country with the seeds of other grasses, and is occasionally met with in grain fields and about dwellings. The grain contains a narcotic or poisonous principle, which causes eruptions, trembling, and vertigo in man and flesh-eating animals. If the seeds are malted with barley, the ale causes intoxication very suddenly. It is contended by some that perfectly healthy Darnel seeds are innocuous—that only grains which are ergotized or otherwise diseased are injurious.

No. 135. Manisuris. Rat-tail-grass.

The native species of *Manisuris* are branching, leafy perennials, with slender, cylindrical, many-jointed spikes, which readily break up. They are found chiefly in the pine-barren swamps of the Gulf States. They are of little agricultural value in this country. *Manisuris compressa*, a native of southern Asia, south Africa, and Australia, where it is called Mat-grass, has creeping or ascending flattened stems, rather short leaves, and slender spikes. In some parts of Australia it is highly esteemed for pasturage, and is said to retain its greenness throughout the year in dry climates. It is not injured by light frosts. The prostrate stems sometimes attain a length of 5 or 6 feet. A closely related species, *M. fasciculata,* occurs on the lower Rio Grande.

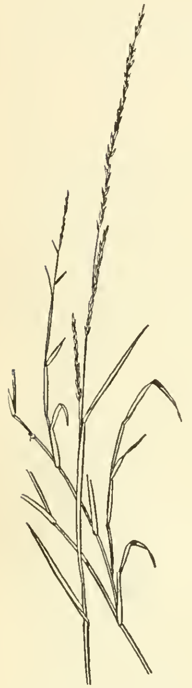


Fig. 55.—Nimble Will (*Muhlenbergia diffusa*).

No. 136. Melinis minutiflora Beauv. Molasses-grass.

A sweet and highly nutritious species, and the most esteemed of the grasses of central Brazil, where it is native, growing upon the hills and dry lands. It is regarded a most excellent grass for dairy cows, and deserves a trial in the Southern and Southwestern States and California. The Brazilian names for this grass are *"Capim mellado"* and *"Capim gordura."* The English name given above is a translation of these. This species occurs also in Ascension Island, Natal, and Madagascar.

No. 137. Muhlenbergia diffusa Schreb. Nimble Will. (Fig. 55.)

A low, slender, diffusely branched grass growing on dry hills, in woods, and especially in shady, waste grounds about dwellings. The leafy, wiry stems, which are from 6 to 18 inches long, spring from extensively creeping and rather tough rhizomes, which make a turf very difficult to break up. When young, this grass is readily eaten by all kinds of stock, but after it matures it is so tough that few animals will touch it. It possesses really very little agricultural value, and some look upon it rather as a weed. It is a native from southern New England to Iowa, Michigan, and southward, blooming in the latter part of summer.

No. 138. Muhlenbergia distichophylla Kth. Bearded Saccaton.

This is a strong, firmly rooted grass, 3 to 4 feet high, with rather long and rigid leaves, and a narrow panicle often exceeding a foot in length. It is frequent in the rich valleys in Arizona and New Mexico, and on rich bottom lands it is often cut for hay. It is a coarse grass, like *Sporobolus wrightii,* and by the settlers is classed with it under the general name of Saccaton. In Arizona it forms the more common "hay" that one finds in the towns and way stations, being pulled by the Mexicans or Indians and brought in on the backs of donkeys or on carts. There are many species of *Muhlenbergia* in the south western part of the United States and northern Mexico, and doubtless many of them are of considerable agricultural value. *Muhlenbergia virescens* is a soft and leafy species growing in clumps on the higher slopes of the mountains in Arizona, and with *Poa fendleriana* forms the chief herbage of the so-called "deer parks" of the mountains. (Pringle.)

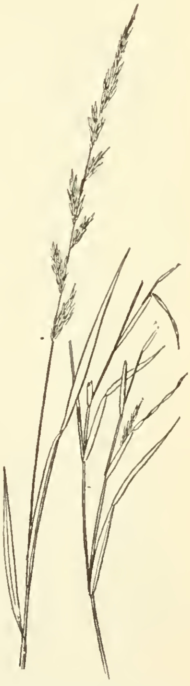


Fig. 56.—Knot-root grass (*Muhlenbergia mexicana*).

No. 139. Muhlenbergia mexicana (Linn.) Trin. Knot-root grass. (Fig. 56.)

A much-branched, leafy perennial, 2 to 3 feet high, with strong, scaly, creeping rootstocks, which often do good service in binding river banks, along which this grass frequently grows. In the Northeastern States this grass is common in low meadows, where it occasionally forms a considerable proportion of the native hay of such places. If cut before the stems have become woody, which they do after flowering, the hay produced is of good quality. It ranges from New England southward to the Gulf and westward to the Rocky Mountains. In the Eastern States it blooms in August.

No. 140. Muhlenbergia porteri Scribn. Wire grama.

This grass is a native of New Mexico and Arizona, growing on the dry mesas and table-lands. It has a straggling habit of growth. The stems are 1 to 2 feet long, much branched, and often matted together. It furnishes excellent feed for cattle in the regions where it grows, and yields good hay, which is harvested in considerable abundance by the ranchmen. It withstands drought very well, but is soon run out under the continued trampling of cattle.

No. 141. Muhlenbergia pungens Thurb. Blow-out grass.

A rather rigid perennial, 12 to 18 inches high, with firm sharp-pointed leaves and open panicles. It has strong, creeping roots, and often does good service as a sand binder. In the sand-hills region of Nebraska it grows abundantly around the borders of the so-called "blow-outs," preventing their extension and assisting materially in restoring the turf. In some parts of Arizona where it occurs it is esteemed a valuable forage plant. It grows from Nebraska southward to New Mexico and Arizona, and along the Colorado River above Fort Yuma.

No. 142. Muhlenbergia racemosa (Michx.) B. S. P. Wild Timothy. (Fig. 57.)

An upright, usually sparingly branched perennial, 2 to 3 feet high, with densely flowered, narrow panicles 2 to 4 inches long, often resembling those of timothy. The rootstocks are very tough, and closely covered with thickened scales. It frequents bogs and low grounds from New England westward to the Rocky Mountains, extending southward to Tennessee, New Mexico, and Texas. It is little prized in the East, but in the Northwestern States is recommended as an excellent grass for hay.

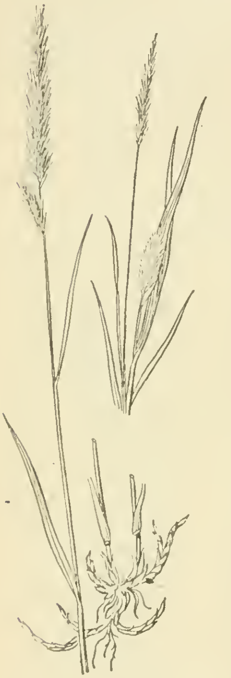


Fig. 57. — Wild Timothy (*Muhlenbergia racemosa.*)

No. 143. Opizia stolonifera Presl. Mexican Lawn-grass.

An extensively creeping, diœcious grass, the very slender, prostrate stems sending up leafy tufts 1 to 4 inches high. Similar in habit to Bermuda, but more delicate. According to Dr. E. Palmer, this is one of the most important grasses of Mexico. Growing close to the ground, it forms a thick sod over all exposed surfaces, even over the cobblestones in the streets of towns. It is used in the public squares with good effect. By regular watering it is easily kept green, and but little cutting is necessary. The seed is difficult to obtain, owing to the constant nibbling of domestic animals. Propagation by cuttings of the rooting, prostrate stems is probably the best method. Trials with this grass ought to be undertaken in the Southern States, both for lawns and pastures.

No. 144. Oplismenus setarius R. & S. Creeping Beard-grass.

A slender perennial of the Gulf States, with decumbent or creeping stems, and short and rather broad leaves. It possesses no recognized agricultural value, but as it grows naturally under the dense shade of trees it might be used for covering the ground in shady places where other grasses will not thrive. It can be propagated by pieces of the stem, which root at the joints, and if cared for, will in a short time make a good turf. A closely allied grass of similar habit of growth, with variegated leaves, is often grown in greenhouses for its ornamental appearance.

No. 145. Oryza sativa Linn. Rice.

A tropical or subtropical, semiaquatic grass, the grain of which is the staple food of one-third of the human race. It is most extensively cultivated in southern Asia, China, and Japan. The annual produce of these countries is estimated at 100,000,000 tons. The rice-growing districts of China support the densest population in the world. In this country rice is cultivated in the States of South Carolina, Georgia, Louisiana, and Texas. The estimate of the crop of cleaned rice produced in Louisiana in 1895 was 82,436,832 pounds. "Paddy" is the grain in the husk. There are many varieties of rice, distinguished by color or size of the grain, absence or presence of beards, etc. There are two classes known as "lowland rice" and "upland rice." The latter is cultivated to some extent in western Tennessee. Rice straw is used for making paper.

No. 146. Oryzopsis asperifolia Michx. Mountain Rice.

A perennial, 6 to 18 inches high, with very long basal leaves overtopping the stems. This grows in rich, open woods, upon hillsides, from New England to Minnesota and northward. It is one of the early blooming species, flowering in May and ripening its seed in June and July. The leaves remain green throughout the winter.

No. 147. Oryzopsis melanocarpa Muhl. Black-fruited Mountain Rice.

A rather stout, long- and broad-leafed grass, 2 to 3 feet high, with a simple panicle of a few rather large spikelets. Grows in rich, rocky woods from New England southward to Pennsylvania and westward to the Rocky Mountains, blooming in July and August. These species of *Oryzopsis* have no recognized agricultural value, but they are very hardy perennials and might be propagated .o advantage in woodland parks.

No. 148. Oryzopsis micrantha Thurb. Small Indian Millet.

A perennial, quite widely distributed throughout the central and western counties of the Dakotas and in eastern Montana. It grows in dry, sandy soil, and though tough and wiry, is nutritious and is considered a valuable grass.

No. 149. Oryzopsis miliacea (Linn.) Hack. Many-flowered Millet-grass.

A perennial, 2 to 3 or 4 feet high, with a many- and small-flowered nodding panicle, 6 to 12 inches long. It is a native of central and southern Europe, growing in dry, open woods and thickets. Was introduced into California in 1879, and has been cultivated experimentally with varying success at a number of points in that State. On the granitic soil of San Diego, California, it has grown 3 feet high without irrigation, and remained green throughout the year. Horses and cattle are said to eat it greedily. In Europe it is not regarded as possessing much, if any, agricultural value.

No. 150. Panicularia americana (Torr.) MacM. Reed Meadow-grass.

A stout, erect, leafy perennial, 3 to 4 feet high, with long, rather broad leaves, and a large, nodding panicle. It is common in the northern Middle States and southward along the mountains to Tennessee and North Carolina, extending westward to the Rocky Mountain region. It grows along streams and in moist meadows, and in such places often forms a considerable portion of the native hay. It is liked by cattle and is a good pasture grass for wet lands.

No. 151. Panicularia canadensis (Michx.) Kuntze. Rattlesnake-grass. (Fig. 58.)

A grass similar in habit to the last and growing in similar situations in the Northern States, extending southward to Pennsylvania and westward to Kansas. It is less common than *P. americana.* It has received no attention from the agriculturist. The nodding panicles of rather large spikelets are sometimes gathered for dry bouquets.

No. 152. Panicularia fluitans (Linn.) Kuntze. Floating Manna-grass. (Fig. 59.)

This grass grows to the height of from 3 to 5 feet, and has a narrow panicle composed of rather few long and narrow or cylindrical spikelets. It is a cosmopolitan species, found in all temperate regions of the world, and is regarded as one of the best fodder grasses for swampy meadows. In some parts of Europe the seeds are gathered and used for human food in the form of soups and gruels.

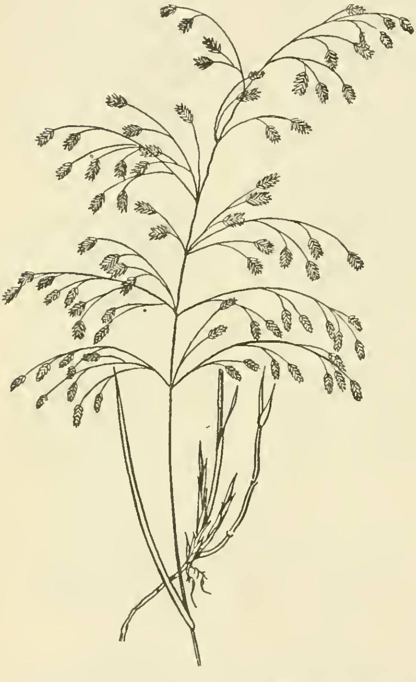


Fig. 58.—Rattlesnake-grass (*Panicularia canadensis*).

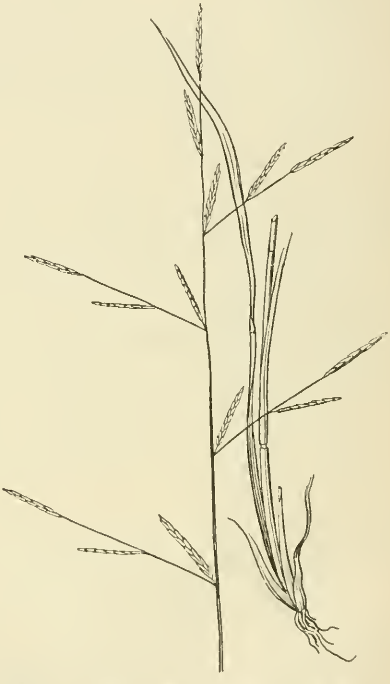


Fig. 59.—Floating Manna-grass (*Panicularia fluitans*).

No. 153. Panicularia nervata (Willd.) Kuntze. Fowl Meadow-grass. (Fig. 60.)

A leafy perennial, 1 to 3 feet high, with expanded nodding panicles of small spikelets. This is a common species in low meadows and moist grounds, extending from New England southward to the Gulf States and westward to the Pacific coast. It is a good fodder plant for moist meadows. Varies greatly in size, according to soil and location. *Panicularia americana* and *Panicularia nervata* furnish food for water fowl during the fall migrations and are valuable in game preserves along with *Zizania aquatica.*

No. 154. Panicum agrostoides Muhl. Munro-grass. (Fig. 61.)

A native perennial, with branching, leafy stems, 2 to 4 feet high, and a panicle resembling that of Redtop. It grows in low meadows and along the banks of creeks, shores of ponds, etc., and often yields a large amount of very good native hay. In low, moist, and rather rich meadows its cultivation would doubtless be profitable, and it is certainly deserving of a trial in such locations.

No. 155. Panicum amarum Ell. Bitter Panic-grass. (Fig. 62.)

A grass of the sandy seacoasts, ranging from Connecticut southward to Florida and along the Gulf. It has coarse, hard stems, 1 to 5 feet high, and strong, creeping rootstocks, making it an excellent sand binder. The islands off the coast of Mississippi are almost wholly made up of drift sands, the outer sides being dunes from 10 to 30 feet high, while the middle of the islands is usually low and occupied by swamps or lakes. This bitter panic is very abundant upon the outside of these dunes, where it is exposed to the winds and waves, and where it serves to effectually bind the otherwise shifting sands. The leaves and stems have a bitter taste, hence the common name.

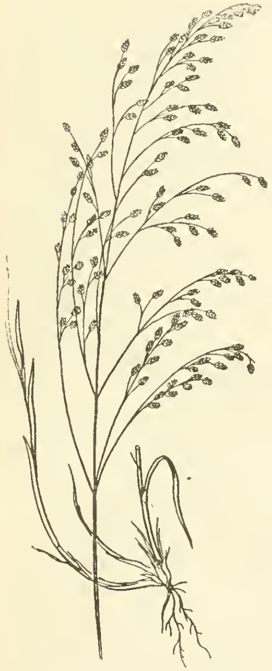


Fig. 60.—Fowl Meadow-grass (*Panicularia nervata*).

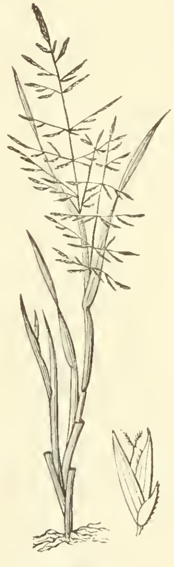


Fig. 61.—Munro grass (*Panicum agrostoides*).

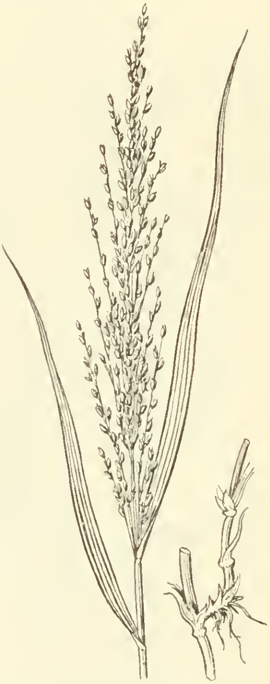


Fig. 62.—Bitter Panic-grass (*Panicum amarum*).

No. 156. Panicum capillare Linn. Old Witch-grass.

An annual, with usually coarse, branching stems, 1 to 3 feet long, hairy leaf sheaths, and widely spreading panicles. Grows in cultivated grounds, where it often becomes a somewhat troublesome weed. Being an annual, however, it is easily eradicated. Possesses no value for fodder excepting for fall feed on stubble.

No. 157. Panicum ciliatissimum Buckl. Indian Wheat.

A more or less extensively creeping perennial, with short leaves and upright flowering stems, 6 to 18 inches high. The panicles are narrow and few flowered, and in the prostrate forms usually partly included within the leaf sheaths. This grass is a native of western Texas, and doubtless possesses some agricultural value for the drier regions of the Southwest. The creeping stems resemble somewhat those of Bermuda-grass, but the leaves are usually more crowded and broader in proportion to their length.

No. 158. Panicum colonum Linn. Shama Millet.

A native of the tropical and warmer temperate regions of the Old World. In northern India it is considered one of the best fodder grasses. Introduced into the Southern and Southwestern States, where it is occasionally found in waste grounds about dwellings. It is closely related to *Panicum crus-galli*, differing from that grass in its smaller size and more simple inflorescence. The stems and leaves are tender and readily eaten by stock. In India the grain, which is produced abundantly, is sold in the markets and used for food.

No. 159. Panicum crus-galli Linn. Barnyard-grass. (Fig. 63.)

This well-known annual of rank growth is common in rich, cultivated ground, especially around dwellings. There are several forms presented by this species. That growing as a weed around barnyards and dwellings, in cultivated grounds in the Atlantic States, was probably introduced from Europe. There are, however, several native varieties, or possibly good species. One of these occurring in the brackish marshes or meadows along the seacoast, grows to the height of 3 to 5 feet, with the lower leaf sheaths very hirsute, and the spikelets long-awned. A tall, smooth form occurs in New Mexico, Arizona, and the Mohave desert region, springing up after the summer rains in all swampy places or lowlands. It grows to the height of 6 or 7 feet, and its seeds, which it produces abundantly, are collected by the Mohave Indians, ground into flour, and cooked for food. The poorer classes of India also use the grain for food. A variety introduced from Japan has been cultivated at some of the experiment stations and treated as a millet. At the Hatch Experiment Station, in Massachusetts, the crop produced was very uniform, averaging 7 feet in height. The yield was at the rate of 11,207 pounds of straw per acre and 66.7 bushels of seed. When sown for silage or for soiling at the rate of one peck of seed to the acre, the yield was at the rate of from 15 to 18 tons per acre. A field sown July 26, after a crop of hay was removed, yielded 12 tons per acre. It is very much liked by stock, and is a valuable forage plant for feeding green or for the silo. It is not so well adapted for hay, as it is a coarse, succulent grass, and rather difficult to dry.

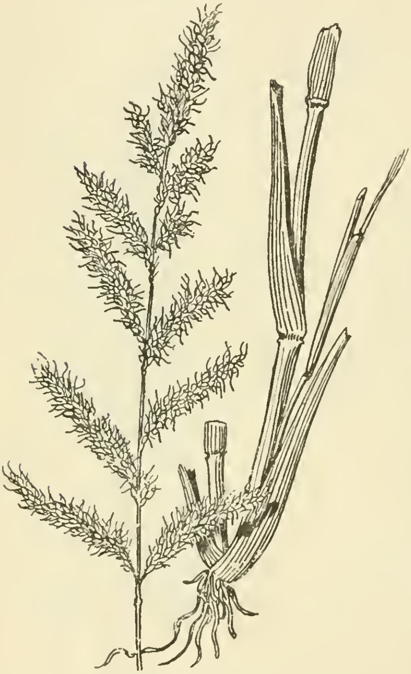


Fig. 63.—Barnyard-grass (*Panicum crus-galli*).

No. 160. Panicum digitarioides Carpenter. Maiden Cane.

A rather coarse grass, 2 to 4 feet high, growing along ditches, in swamps, and in moist sands from Delaware southward to Florida and along the Gulf near the coast. It has strong and widely spreading or creeping rootstocks, which are useful in binding sandy railroad embankments in the Southern and Gulf States.

No. 161. Panicum fasciculatum Sw. Brown-top.

A rather coarse and much-branched leafy annual, growing in clumps to the height of 2 to 3 feet. The leaves are flat, one-fourth to one-half an inch wide, and 2 to 6 inches long. It is a native of Texas and Florida. Similar in character and closely allied botanically to *Panicum texanum*.

No. 162. Panicum lachnanthum Torr. Arizona Cotton-grass.

This is a native of the dry regions of Arizona and New Mexico. It resembles *Panicum lanatum*, but has more slender stems, which rise from strong, woolly, and knotted rootstocks. This may prove to be a valuable pasture grass for the dry or semiarid regions of the Southwest.

No. 163. Panicum lanatum Rottb. Cotton-grass.

A variable species widely distributed throughout the tropical regions of both hemispheres. It is a perennial with slender or stout stems 1 to 3 feet high, usually with flat leaves and narrow panicles, the spikelets being densely clothed with long silky or cottony hairs, which are white, or sometimes brownish or purplish. When abundant this grass yields excellent pasturage. It has been found in southern Florida and at other points near the Gulf coast. There is a variety of this species growing in the dry regions of Arizona and New Mexico which has more slender stems, that spring from strong woolly and knotted rhizomes. Doubtless this form would be a valuable pasture grass for the dry or semiarid regions where it is native.

No. 164. Panicum maximum Jacq. Guinea-grass. (Fig. 64.)

This grass was long ago introduced into America, presumably from tropical Africa, and has for many years been cultivated in tropical South America and the West Indies. In these regions it is spoken of as being a splendid pasture grass, growing to the height of 12 feet, forming dense tufts. It is readily propagated by cuttings of the creeping rootstocks. It has been introduced into some of the Gulf States, particularly Florida, where it is highly valued. Few grasses yield a larger amount of fodder, and it may be cut as often as once a month during the growing season. If allowed to attain its full size it becomes coarse and unfit for forage. Its stems are killed by the first frosts of autumn. It seeds only in the warmest parts of the States bordering the Gulf. It is much less hardy than Johnson-grass, with which it has been confounded by some, and has quite a distinct habit of growth.

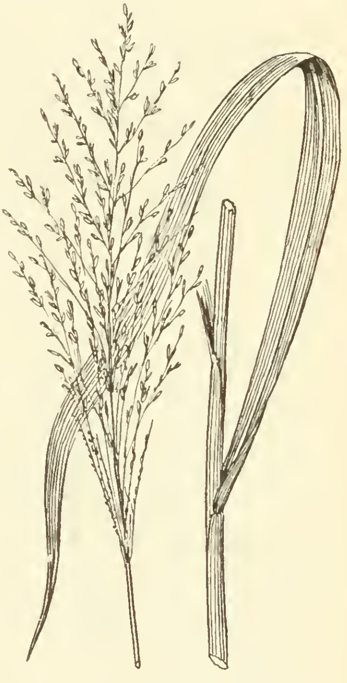


Fig. 64.—Guinea-grass (*Panicum maximum*).

No. 165. Panicum miliaceum Linn. Broom-corn Millet.

A rather coarse annual, attaining a height of 2 to 4 feet, with large, drooping, loosely flowered panicles. There are several varieties, distinguished by the color of the fruit or character of the panicle. This is the true millet which has been cultivated in the East from prehistoric times, so that now its native country is not known. It is still cultivated to a considerable extent in China and Japan, also in South Russia and Roumania, and to a limited extent in other parts of Europe and North Africa. It requires a rich soil, and under favorable conditions its growth is very rapid and its production of seed large, in some instances amounting to 60 or 70 bushels to the acre. The grain is nutritious, and is one of the best for feeding poultry. When ground, the flour makes a rich and nutritious porridge, for which purpose it is chiefly used in the eastern countries where the grass is grown. In northern India, where the grain is largely used, a preparation of it constitutes a favorite food at marriage ceremonies. Owing to its rapid and somewhat succulent growth, it is an excellent soiling plant. It has, however, been little cultivated in this country, but is occasionally found in the older settlements in cultivated fields and waste grounds about dwellings. The number of grasses termed millets in various parts of the world is large, and includes many very different species, whose grain, however, is used for human food. Most of the so-called millets belong to the genera *Chætochloa*, *Panicum*, and *Paspalum*. They form the principal food grains of the natives of many parts of Africa and Asia. It has been estimated that the millets feed one-third of the human race.

No. 166. Panicum molle Sw. Para-grass.

A rather coarse, reed-like perennial, 4 to 6 feet high, with hairy nodes, and narrow, lax panicles, 6 to 8 inches long. It is cultivated in South America, and in the West Indies and Mexico, and has been introduced into some of the Gulf States. It is grown with success on the high pine ridges of Florida, and wherever cultivated it is most highly esteemed and regarded as a very fattening pasture grass. How far to the north this grass may be grown successfully does not appear to have been determined, but it is hardy at the Cape of Good Hope and other far extra tropical regions (Baron von Mueller). It is propagated either by seeds or root cuttings.

No. 167. Panicum obtusum H. B. K. Vine Mesquit.

A stoloniferous grass, the runners attaining a length of 8 to 10 feet, the upright flowering culms 12 to 24 inches high. This grass ranges from Colorado to Texas, New Mexico, Arizona, and southward into Mexico. It is usually found in irrigated lands or in the low, damp soil of the valleys, most frequently under the shade of trees and shrubs. No attempts have been made to cultivate this grass, but its appearance and habit of growth indicate an agricultural value of sufficient importance to call for experiments in its cultivation. In New Mexico this species is called "Wire-grass."

No. 168. Panicum plicatum Lam. Palm-leafed Grass.

A broad-leafed perennial, 3 to 4 feet high or more, native of India. The leaves are elegantly striate and usually plicate, giving to the grass an unusual and at the same time attractive appearance. It is a favorite ornamental for greenhouse culture.

No. 169. Panicum proliferum Lam. Sprouting Crab-grass.

A smooth and usually much-branched native annual, with rather coarse, spreading or ascending stems 2 to 6 feet long, flat leaves, and diffuse terminal and lateral panicles. It grows naturally in moist, rich soil along the banks of streams and rivers, around the shores of ponds and lakes, and in the South is often abundant in rich, cultivated fields, growing with Crab-grass. The stout, succulent stems are sweetish and much liked by horses and cattle. Its range is from Maine to Nebraska, and southward to the Gulf, blossoming in the latter part of summer or early autumn. The spontaneous growth of this grass in cultivated fields after the removal of crops is of some value for hay or pasturage, but its cultivation can not be recommended in view of the fact that we have many annual grasses much superior to it. In the Northern and Middle States it is classed with the weeds.

No. 170. Panicum repens Linn. Creeping Panic.

An extensively creeping grass, with rather stiff upright stems, 1 to 2 feet high or less. It is common in the maritime districts in southern Asia, northern Africa, southern Europe, and Australia. It is also found along the shores of the Southern States bordering the Gulf, extending westward to Mexico. It has no agricultural value, but is a natural sand binder. Upon the sandy islands lying off the Gulf Coast it grows abundantly upon the outside of dunes, protecting them from the action of the winds and waves.

No. 171. Panicum sanguinale Linn. Crab-grass. (Fig. 65.)

A well-known annual, common in nearly all parts of the United States, growing in cultivated fields and about dwellings. It is a weed in gardens and among hoed crops. In grain fields after harvest it frequently springs up in such quantity, particularly in the Southern States, as to yield one or even two good cuttings of hay. This spontaneous growth affords excellent pasturage, as well as hay of first quality if properly cured. The stems are much branched, and in good soil attain a length of 3 to 4 feet. This grass contains little fiber, and dries quickly when cut, but if after cutting it is wet by rains or heavy dews its value for hay is almost wholly destroyed. In Bohemia, Crab-grass is cultivated upon sandy soils and the grain is used for food in the form of mush or porridge.

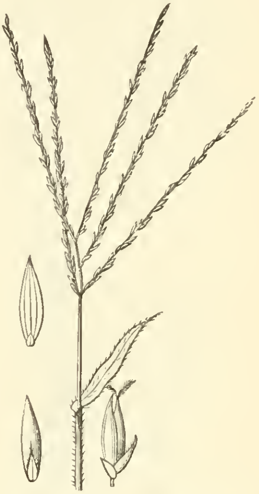


FIG. 65.—Crab-grass (*Panicum sanguinale*).

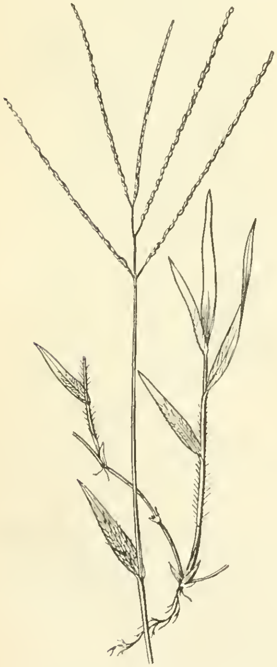


FIG. 66.—Creeping Crab-grass (*Panicum serotinum*).

No. 172. Panicum serotinum (Michx.) Trin. Little Crab-grass. (Fig. 66.)

A species related to Crab-grass (*Panicum sanguinale*), common in the Southern States near the Gulf, disputing with Louisiana-grass the claim of being the most valuable native pasture grass of that section. It is probably a biennial. It is much like Crab-grass, sending out leafy, creeping shoots at every joint, but is smaller in every way, with shorter and more hairy leaves of a lighter green color. It is invaluable for pasturage, forming a close turf, and driving out nearly all other plants. It grows best in sandy soil where there is a little moisture.

No. 173. Panicum spectabile Nees. Angola-grass.

A stout grass, 3 to 5 feet high, with rather broad and long (1 to 2 feet) leaves, and a terminal, densely flowered, compound and narrow spike 8 to 10 inches long. Imported into South America many years ago from the west coast of Africa (the region of Angola). It is cultivated on the low lands in the eastern part of Brazil, particularly in the region of Rio de Janeiro, where it is called "Capim d'Angola." This Panicum is closely related to and resembles some forms of Barnyard-grass (*P. crus-galli*). It is spoken of as an extremely productive and nutritious fodder-grass, and may prove valuable for the low regions along the Gulf coast.

No. 174. Panicum sulcatum Aubl. Palm-Leafed-grass.

A South American perennial, 4 to 6 feet high, with palm-like leaves 1 to 2 inches broad and 16 to 20 inches long, and long, terminal, narrow panicles which taper above and below. The leaves of this grass are deeply sulcate or plicate, like those of the Indian *P. plicatum.* Sometimes cultivated for ornament in greenhouses or upon lawns.

No. 175. Panicum texanum Buckl. Colorado-grass. (Fig. 67.)

A branching, leafy annual, 2 to 4 feet high, with a narrow panicle 6 to 8 inches long terminating the main stem and branches. It is nutritious, of rapid growth, and upon good soil yields a large amount of excellent hay, and may be cut twice or even three times during the season. It reseeds itself readily. It prefers rich, alluvial soil along river bottoms, etc., and upon such land withstands drought well. In certain parts of Texas, particularly in the counties along the Colorado River, in the central part of the State, where it appears to be native and where it often comes up in cultivated fields after the removal of corn or other grain crops, it is spoken of in the highest terms as a hay-producing grass.

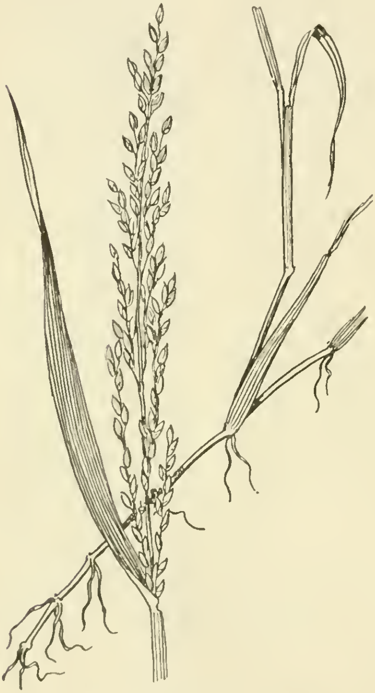


Fig. 67.—Colorado-grass (*Panicum texanum*).

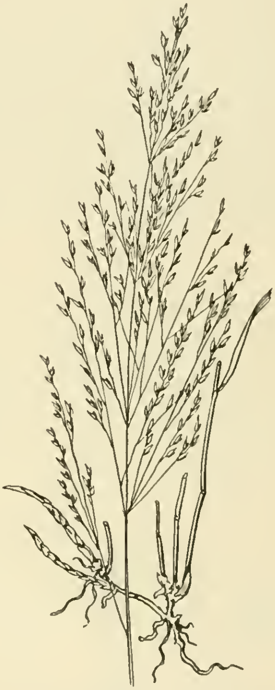


Fig. 68.—Switch grass (*Panicum virgatum*).

No. 176. Panicum virgatum Linn. Switch-grass. (Fig. 68.)

A tall, native perennial, 3 to 5 feet high, with strong, creeping rootstocks, long, flat leaves, and ample, spreading panicles. When young this affords good grazing, but at maturity the stems become hard and practically worthless for fodder. It ranges from Maine southward to the Gulf and westward to the Rocky Mountains. It is particularly common near the coast in sandy soil bordering the marshes, and oftentimes plays an important part there, in preventing the drifting of sands by the winds or the washing of soils by overflows and high tides. On good lands it is very productive, and if cut before the stems have become hard yields a large amount of hay of very good quality.

No. 177. Pappophorum laguroideum Schrad.

A handsome ornamental, 3 to 5 feet high, with narrow, plume-like panicles a foot or more long. It is a native of Mexico, and has been successfully grown from seed on the grounds of the Department of Agriculture. It is worthy of introduction as an ornamental for gardens and lawns because of the beauty of its pale straw-colored panicles.

No. 178. Pappophorum wrightii S. Wats. Purple-grass.

A slender and apparently annual grass of western Texas, New Mexico, and Arizona, growing on the open plains and among the foothills of the mountains. It has short, narrow leaves and narrow, densely flowered heads or panicles, which are softly bearded and grayish or purplish. It is said to be fully equal to Grama or Buffalo-grass in nutritive value, and more palatable to horses or mules.

No. 179. Paspalum boscianum Flügge. Purple Paspalum.

A rather stout perennial with ascending branching stems, 2 to 3 feet high, long, flat leaves, and numerous racemes crowded near the summit of the culm and its branches. It is a native of the Southern States, growing in moist grounds, preferring rather heavy soils. Like other species of Paspalum, it grows in tufts and often occurs covering considerable areas to the exclusion of other grasses. It yields a good bulk of sweet hay, but is rather slow in drying.

No. 180. Paspalum compressum (Sw.) Nees. Carpet-grass.

A slender, erect, or more frequently prostrate and extensively creeping perennial, rooting at the nodes, and sending up numerous leafy, flower-bearing branches, 6 to 24 inches high. The very slender racemes or spikes borne at or near the summit of the stems are 1 to 3 inches long. The prostrate creeping stems spread rapidly, and soon form a dense, carpet-like growth. crowding out all other vegetation. It withstands protracted drought, grows well on almost any soil, and in the more southern districts is evergreen, yielding good pasturage both summer and winter. It is regarded as one of the most valuable native pasture grasses of the regions bordering the Gulf, and is a most excellent lawn grass, superior to Bermuda and less difficult to eradicate. It is found in the warmer regions of both North and South America. It is readily propagated by sets and seeds.

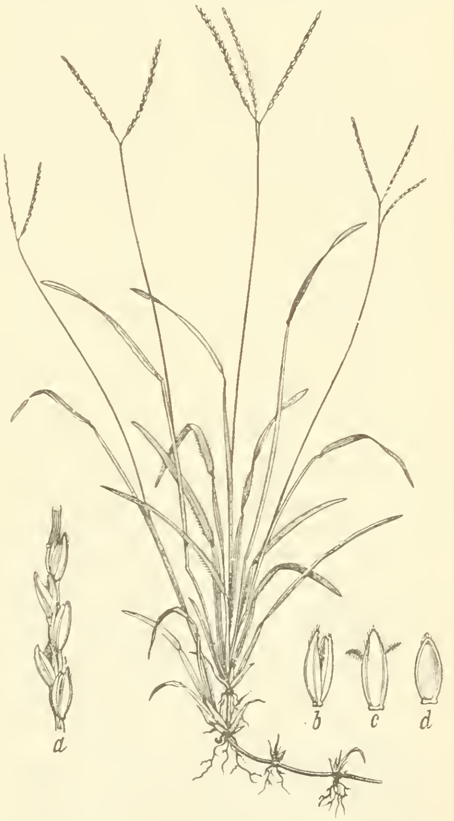


FIG. 69.—Carpet-grass (*Paspalum compressum*): *a*, attachment of spikelets to rachis; *b* and *c*, spikelets; *d*, floret.

No. 181. Paspalum dilatatum Poir. Large Water-grass.

A rather coarse leafy perennial, growing in clumps 2 to 5 feet high, bearing near the summit of the stems two to ten, more or less spreading racemes or spikes of crowded, hairy spikelets. It is a native of Brazil and possibly was originally introduced into the Southern States (where it has become quite widely distributed) from that country, although it may be a native here. It ranges northward from the Gulf to southern Virginia and Tennessee, and westward to Texas, growing most abundantly on low, black soils, which are well supplied with moisture. It is considered an excellent pasture grass, and when well established endures seasons of excessive drought without injury. It is particularly valuable as furnishing excellent late summer and autumn feed, during which period it makes its principal growth.

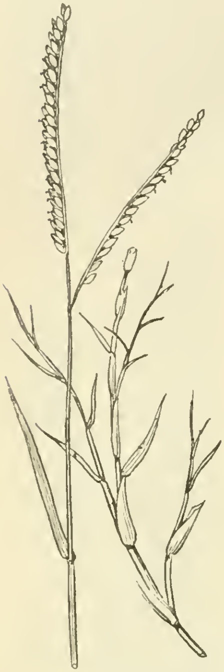


FIG. 70.—Knot-grass (*Paspalum distichum*).

No. 182. Paspalum distichum Linn. Knot-grass. (Fig. 70.)

A low creeping species, resembling Bermuda-grass. It is common in the Southern States along the seacoast and in the interior, extending southward from Virginia to the Gulf, and westward to Texas, Arizona, southern California, and northward to Oregon. It occurs throughout the tropical regions of both the Old and New Worlds. It grows in more or less sandy soils around the margins of ponds and along river banks. In such places it often does good service in binding soils subject to wash. The grass can well be recommended for this use. Its stems are somewhat succulent, extensively creeping, rooting at the nodes. The leaves are tender, affording excellent grazing. The upright stems are a few inches to a foot high, and bear at their summits two slender spikes. This character at once serves to distinguish it from Bermuda, which has several spikes at the apex of the flowering culms.

No. 183. Paspalum læve Michx. Smooth Paspalum. (Fig. 71.)

A tufted native perennial, with ascending or erect stems, 1 to 3 feet long, flat leaves, and two to five, more or less spreading spikes, 2 to 4 inches long. Common in the Middle and Southern States, growing in open fields, meadows, etc., usually where the ground is somewhat moist. It is a late summer grass, blossoming from July to October. Well liked by all kinds of stock. In cultivated grounds, and particularly on lawns, which it occasionally invades, it must be classed as a weed.

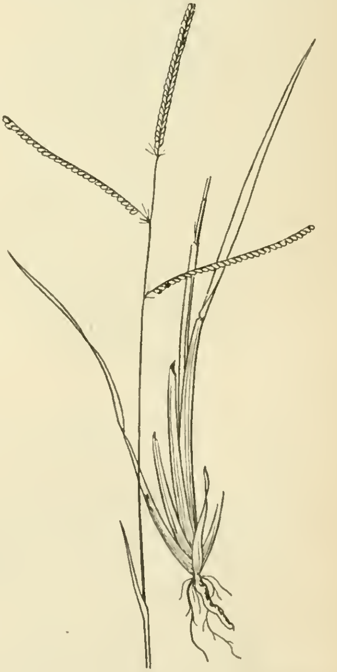


FIG. 71.—Smooth Paspalum (*Paspalum læve*).

No. 184. Paspalum scrobiculatum Linn. Ditch Millet.

A smooth annual, with branching, erect or ascending stems, 2 feet high or more. Widely distributed throughout the tropical and subtropical regions of both hemispheres. In northern India this grass is cultivated throughout the plains-region as a "rainy-season crop." It is usually sown on the poorer kinds of soil, the grain being chiefly consumed by the lower classes. The straw is used for fodder. (Duthie.) A variety of *P. scrobiculatum*, called "hureek" in India, which is perhaps the Ghohana-grass, an Indian species reputed poisonous, is said to render the milk of cows that graze upon it narcotic and drastic. (Lindley.)

No. 185. Pennisetum japonicum Trin.

Erect, with flattened simple stems, 1 to 2 feet high, very narrow leaves, and comparatively loosely flowered purplish or yellowish nodding panicles. A native of Japan. Occasionally cultivated as a curiosity or for ornament.

No. 186. Pennisetum latifolium Spreng.

A rather broad-leafed ornamental perennial, 3 to 5 feet high, branching above, with greenish rather dense panicles 1½ to 2 inches long. Native of Uruguay and Argentina. In the latter country it is used for covering roofs of houses. Occasionally found cultivated here as an ornamental grass. It forms large tufts and is easily propagated by the roots or seeds. It may possess some value as a forage plant.

No. 187. Pennisetum macrourum Trin.

A South American species, with unbranched stems, 3 to 4 feet high, and densely flowered, cylindrical, yellowish panicles 6 to 8 inches long. Cultivated occasionally for its odd and ornamental appearance.

No. 188. Pennisetum spicatum. Pearl Millet.

An annual of luxuriant growth, 6 to 10 feet high, with long, broad leaves, stout culms, and terminal, erect, cylindrical, dense spikes 6 to 12 inches long, closely resembling those of the common cat-tail of the marshes. It is a native of the East, where it has been cultivated for its grain for many years. It is an important agricultural grass of Central Africa. It requires a rich loose soil to obtain the best growth, and under favorable conditions produces an enormous quantity of green fodder, for which purpose it can be cut several times during the season. It does not dry out readily and is often difficult to cure into hay. It has been cultivated with success as far North as Pennsylvania and in many parts of the South for a good many years. It is best sown in drills, about 2 feet apart, and 5 to 6 pounds of seed are required per acre. The weight of good seed per bushel is 56 pounds. The current price is $12 to $14 per 100 pounds.

No. 189. Pennisetum villosum Brown.

An Abyssinian species which has been introduced into cultivation because of its ornamental appearance. It grows to the height of 1 or 2 feet, has long narrow leaves, and dense, oblong or cylindrical, finely bearded heads 2 to 4 inches long. It is a hardy perennial, graceful and attractive in appearance, and is very frequently cultivated as an ornamental under the name of *Pennisetum longistylum*.

No. 190. Phalaris arundinacea Linn. Reed Canary-grass. (Pl. III, fig. 3.)

A tall, leafy perennial, 2 to 4 feet high, from a creeping rootstock, with smooth sheaths and narrow, branching panicles 4 to 8 inches long. It is a native, common on low, wet grounds, from New England southward to Tennessee, and extending across the continent to California and Washington. It is native also in Europe and northern Asia. It is little affected by either drought or cold, and thrives well in the shade. It succeeds best on stiff, wet land, and on wet, flooded fields and will grow fairly well upon rather dry, sandy soil. The rootstocks are very strong and creep extensively, making this grass particularly valuable for binding banks of rivers and ditches where the water supply is ample. It does not attain its full size until the second year, and if designed for hay should be cut before flowering, for when fully mature the stems become woody and are too hard to make good fodder. The seed, which matures in July and August, is easily gathered. Good seed should have 95 per cent purity and 60 per cent germination. It may be propagated by seed or by cuttings of the rootstocks, these being laid down at intervals of 1 foot, and slightly covered. The retail price of seed quoted in the New York market is $35 per 100 pounds. A variety with white-striped leaves, called Ribbon-grass, is cultivated in gardens for ornament.

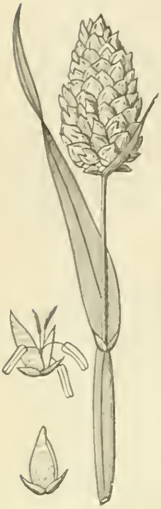


Fig. 72.—Canary-grass (*Phalaris canariensis*).

No. 191. Phalaris canariensis Linn. Canary-grass. (Fig. 72.)

An erect annual, 1 to 3 feet high, with flat leaves, and dense, ovoid panicles or heads about an inch long. This grass is apparently a native of the warmer countries of Europe, also of north Africa and western Asia. It has become widely distributed throughout the warmer temperate and tropical regions of the world, including Australia. Cultivated in Germany and southern Europe. It has been introduced into this country, and is occasionally cultivated for its seeds, which are used for bird food. The flour from the seeds is utilized in certain processes of cotton manufacture (weaver's glue), and is even employed in the making of some kinds of cake. It is frequently met with in waste grounds about dwellings in the vicinity of towns.

No. 192. Phalaris caroliniana Walt. Southern Canary-grass; Apache Timothy.

This and *Phalaris angusta* (Fig. 73) have usually been regarded as one species, the latter as a variety with more elongated heads and rather stouter growth. Both the species and variety are perennials, ranging from South Carolina to Florida and westward to Texas, Arizona, California, and northward on the Pacific slope to Oregon. *Phalaris angusta*, a stout grass, 2 to 5 feet high, is sometimes called Apache Timothy, owing to the resemblance of its heads to those of timothy. In California it is not esteemed as of any agricultural value, but in the Southern States it has been cultivated to a limited extent, and is spoken of by some a being an excellent grass for winter and spring grazing, as it remains green throughout the winter season.

No. 193. Phleum alpinum Linn. Mountain Timothy.

This grass is a native of the mountain regions from Maine to California and northward; also in northern Europe and Asia. It is closely related to cultivated timothy. The stems are usually stouter, more leafy, but not so tall, under most favorable conditions attaining a height of 2 feet, but rarely exceeding a foot.

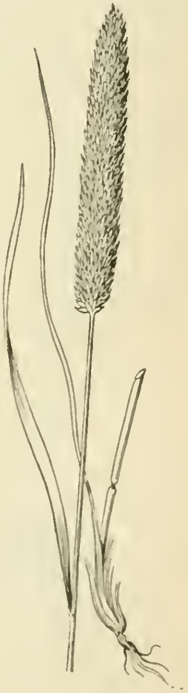


Fig. 73.—Apache Timothy (*Phalaris angusta*).

No. 194. Phleum pratense Linn. Timothy. (Fig. 74.)

This is one of the best known and most extensively cultivated hay grasses. It is a native of Europe (where it is known as cat's-tail), north Africa, and northern and middle Asia, and has become thoroughly naturalized in North America. It appears to have been first cultivated in this country, and it was from this country that the seeds were obtained for its cultivation in England about the year 1760. It has never attained the same high esteem in England that it holds here, where it is regarded as the standard of comparison for all other grasses grown for hay. It succeeds best on moist loams or clays. In very dry ground the yield is apt to be light. On such soils the base of the stem is often thickened and bulb-like. Timothy is usually sown in mixtures with other grasses and clovers. It may be used with red or alsike clovers, or with redtop. Good fresh seed should have an average purity of 97 per cent and a germinative power of 85 to 90 per cent, a bushel weighing 48 pounds. The amount required per acre varies with the quality of the seed, but of that containing 87 per cent pure in germinating, 16 pounds to the acre is sufficient. It is better, however, to sow half a bushel to the acre if sown alone. With red or alsike clovers about 10 per cent timothy is a proper mixture.

No. 195. Phragmites vulgaris (Lam.) B. S. P. Common Reed.

This is one of the largest of our native grasses, growing to the height of 12 feet, the rather stout culms bearing numerous broad, spreading, and sharply pointed leaves 1 to 2 feet long. It has deeply penetrating and extensively creeping rootstocks, making it one of the most valuable grasses for binding the banks of rivers subject to periodical floods. It is occasionally found along the coast in brackish marshes and sometimes upon sandy soils, and possibly may be employed with advantage for binding drifting sands or those liable to be shifted by high tides. The rootstocks are very strong, and when the grass is once established scarcely anything can remove it. The young shoots are liked by cattle and the mature stems make the best of thatch. It is very widely distributed throughout the temperate regions of both hemispheres, growing along river banks, borders of lakes, etc.

No. 196. Poa alsodes A. Gray. Wood Spear-grass.

A slender, erect perennial, 1 to 3 feet high, with flat leaves and a narrow, rather few-flowered panicle. It is a native, growing upon the wooded hillsides of New England, extending westward to Wisconsin, and southward through New York, Pennsylvania, and Virginia, to the mountain regions of North Carolina and Tennessee. It possesses no recognized agricultural value, but is apparently a good fodder grass, and may possibly prove of value in cultivation in woodland parks. Other closely related species of *Poa* extend westward across the continent.

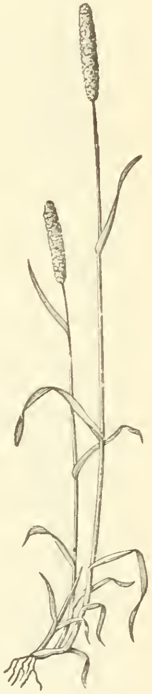


Fig. 74.—Timothy (*Phleum pratense*).

No. 197. Poa annua Linn. Low Spear-grass.

A low, spreading annual, with erect or ascending somewhat flattened stems, 2 to 12 inches high. This is an introduced grass, common in every dooryard and about dwellings and cultivated grounds. It may be found in bloom in the Southern States in almost every month in the year. It often forms a considerable ingredient in poorly kept lawns, as a result of its spontaneous growth.

No. 198. Poa arachnifera Torr. Texas Blue-grass.

A strong-growing perennial, 1 to 3 feet high, with extensively creeping rootstocks, long leaves, and narrow, densely flowered panicles. This grass is apparently diœcious. The pistillate or seed-bearing plants have the spikelets densely woolly, while the male spikelets are smooth. It is a native of Texas, but is now well known in most of the Southern States, where it has been introduced into cultivation, having been highly recommended as a permanent pasture grass. It may be propagated by seeds or "root cuttings," which can be obtained from leading seedsmen. It makes its principal growth during the winter months, coming into bloom in the latter part of April or early in May. It makes a good sod and withstands well the heat of summer and protracted drought. Owing to the woolliness of the seeds, they are difficult to sow, and as they are rather expensive this grass has not been so extensively propagated as it otherwise would have been. A somewhat troublesome, but more certain, method of propagation is by root cuttings. These may be planted at any time during the fall or early spring months, being set out in rows 2 feet apart and 6 to 10 inches apart in the rows. The retail price of the seed, according to New York catalogues, is $3 per pound.

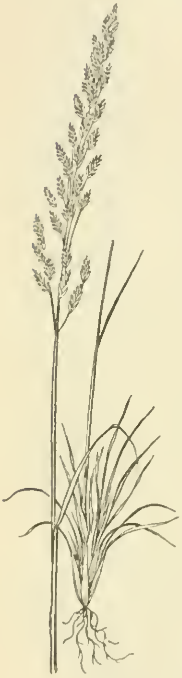


FIG. 75.—Bunch Red-top (*Poa buckleyana*).

No. 199. Poa arida Vasey. Bunch Spear-grass.

A smooth, upright perennial, 1 to 2 feet high, with rather rigid, sharp-pointed leaves, and a close or narrow panicle 2 to 3 inches long. This grass is a native of the Rocky Mountain region, from the British Possessions southward to Arizona. It has short, creeping rootstocks, and although more rigid than many species of *Poa*. is one of the most valuable pasture grasses of the dry regions of the West.

No. 200. Poa buckleyana Nash. Bunch Red-top. (Fig. 75.)

Rather slender, 1 to 2 feet high, with no creeping rootstock, very narrow root leaves, and contracted panicles of usually purplish spikelets. It is a perennial, and a native of the Rocky Mountain regions, growing on the lower foothills and in the valleys. It grows in bunches, not forming a turf, and is regarded by the ranchmen as one of the most valuable "bunch grasses" of the cattle ranges. It has never been introduced into cultivation, but is deserving of attention, for it responds readily to improved conditions, and when growing along streams or in irrigated land makes a luxuriant growth of foliage, and often attains a height of 2 or 3 feet. There are many species of *Poa* native to the northern portion of our country, particularly in the Northwest, and all are tender, nutritious pasture grasses. Wherever grasses grow, from the seashore to the highest mountain tops, from one arctic zone to the other, the genus *Poa* has its representatives.

No. 201. Poa compressa Linn. Canadian Blue-grass.

A slender perennial, with much-flattened stems, 6 to 20 inches high, and small, narrow panicles. This grass has extensively creeping rootstocks, and forms a strong turf. It is a native of Europe, which has become thoroughly naturalized, and is now very widely distributed over our territory. It is closely related to Kentucky Blue-grass, but it is more decidedly blue in color, and is readily distinguished from that species by its strongly flattened stems, lower habit of growth, and smaller panicle. It is the "Blue-grass" of the farmers of the New England and Middle States. It will grow upon a great variety of soils, even upon those so poor and thin as to exclude the growth of other grasses. In cultivated lands it is likely to become troublesome, owing to its creeping rootstocks. There is perhaps no better pasture grass for dry and poor soils, particularly in the Eastern and Middle States. It is especially valuable for dairy pastures; cows feeding on it yield the richest milk and finest butter. On good land it becomes sufficiently tall for hay, and as it shrinks very little in drying, the hay is heavy in proportion to its bulk. Seed is advertised by leading firms at $14 per 100 pounds.

No. 202. Poa fendleriana (Steud.) Vasey. Mutton-grass.

Widely distributed in the Rocky Mountain region and on the Pacific Slope, extending southward through Arizona into Mexico. It grows in tufts to the height of 1 to 2 feet, has numerous long root-leaves, and short, compact heads or panicles. It is tender, and affords a large amount of excellent grazing in the regions where it grows abundantly, and may prove a valuable acquisition to the forage grasses of the Atlantic States.

No. 203. Poa flabellata Hook. Tussock-grass.

A native of the Falkland and adjacent islands, which has attracted the attention of travellers by its stout habit of growth and evident nutritious qualities. The flowering stems are 5 to 8 feet high, and these are often exceeded by the numerous radical leaves. This grass grows in great tussocks, 1 to 4 or 5 feet across. The stems and long leaves are used for thatch. "It loves a rank, wet, peat bog, with the sea spray dashing over it, and wherever the waves beat with greatest vehemenee and the saline spray is carried farthest, there the tussock grass thrives the best, provided, also, it is on the soil it prefers." It thrives in cold countries near the sea in pure sand at the edge of peat bogs. The base of the stem is edible, having a taste of mountain cabbage, a species of palm. The introduction of this grass to certain points along our Northern seaboard, where other grasses will not thrive or where there is danger of encroachment upon the land by the sea, may be desirable. The nutritious qualities of the grass and its furnishing good fodder the year round upon the Falkland Islands has been repeatedly noted by authors.

No. 204. Poa flava Linn. False Red-top.

A native of northern Europe and the northern portions of our own country, growing naturally in wet meadows and along the low banks of streams. It attains the height of 2 to 3 feet, or even 4 feet in rich, moist soils, and has an expanded, nodding panicle of rather small, purplish, or "bronzed" spikelets. It is found in nearly all parts of New England, and often forms a very considerable and valued portion of the native hay of the low meadows. It has been cultivated to some extent, but should only be used in mixtures, as it does not make a good sod when sown alone. It blooms in July and August.

No. 205. Poa nemoralis Linn. Wood Meadow-grass.

The larger forms of this are hardly to be distinguished from *Poa flava*, and have a similar range. It will, however, grow in a drier soil, excessive moisture being harmful to it. In Montana this species ascends to the altitude of 9,000 feet. At this elevation it is dwarfed in habit, but at lower elevations it becomes taller and affords excellent forage. There are several varieties of this grass in the Rocky Mountains and the Northwest, some of them growing upon the dry foothills and bench lands. The larger forms are well adapted for hay. It is less productive than many others, and its cultivation is not recommended, excepting in shady parks or open woodlands where an increase of forage is desired, or in shaded lawns, and then only in the Northern and Middle States.

No. 206. Poa nevadensis Vasey. Nevada Blue-grass.

A perennial bunch grass from the western prairie and plains regions. It grows on both dry and damp soils, produces a large amount of excellent hay, and is apparently worthy of cultivation.

No. 207. Poa pratensis Linn. Kentucky Blue-grass. (Fig. 76.)

This is apparently native throughout the temperate regions of the northern hemisphere. It ranges from Labrador to South Carolina, westward to the Pacific coast and northward to Alaska. In the limestone regions of Kentucky and Tennessee it attains its greatest perfection and is there regarded as the king of pasture grasses. It requires a good soil containing some lime in order to yield profitable crops. It is largely employed in the Eastern and Middle States as a lawn grass, for which use it is well adapted. It makes a good, firm sod, and is particularly well suited for turfing the slopes of terraces and embankments, where the soil is good. There are several varieties, which differ chiefly in the breadth and length of the leaves, particularly those at the base of the stem. It is not so well adapted for the production of hay as it is for pasturage. It should enter into all mixtures designed for permanent pasture. The slender stems of this grass afford an excellent material for the manufacture of the finer kinds of Leghorn hats. Good and well-cleaned seed should have 95 per cent purity and 50 per cent germinating power. The power of germination, however, is usually much below this figure. When used for lawns, sow at the rate of 3 bushels per acre. According to Stebler and Schroeter, the seeds should never be covered, but only rolled after sowing, because they germinate better in the light than in darkness. This is the June-grass of the Northern States, Green-grass of Pennsylvania, and Smooth-stalked Meadow-grass of England.

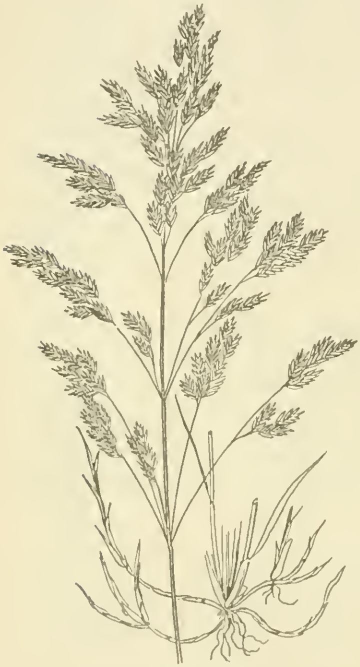


FIG. 76.—Kentucky Blue-grass (*Poa pratensis*).

No. 208. Poa subaristata Scribn. Vasey's Spear-grass.

A perennial, from central Montana, where it is common on dry hills and mountain slopes, forming a large percentage of the grass and supplying good pasturage. It is an excellent species for cultivation in Northern pastures.

No. 209. Poa trivialis Linn. Rough-stalked Meadow-grass.

An erect perennial, 1 to 3 feet high, with an open, spreading panicle, closely related to Kentucky Blue-grass, from which it differs in having no conspicuous rootstock and the stem distinctly rough below the panicle. It has been cultivated for many years in England, and is now highly esteemed as an ingredient in mixtures for permanent pastures. It succeeds best where the climate and soil are rather moist and cool, but is not adapted to sandy soil. In northern Italy this grass is known as the "queen of forage plants," but elsewhere, particularly in this country, it is not so highly esteemed, its principal use being to form bottom grass in permanent pastures. Seed of good quality should have 95 per cent purity and 50 per cent germination. When sown alone 1½ to 2 bushels of seed are required per acre.

No. 210. Poa wheeleri Vasey. Wheeler's Blue-grass.

A perennial native pasture grass that grows on the high plains and on the mountain slopes, below timber line, from Colorado northward. It is one of the best grazing grasses of the Rocky Mountains and promises to do well in cultivation.

No. 211. Pollinia fulva Benth. Sugar-grass.

A slender or rather stout perennial, 1 to 4 feet high, with narrow leaves and two to three terminal spikes, which are clothed with brown, silky hairs. It is a native of Australia, found throughout all the colonies of that country, growing chiefly on the richest soils and on deep alluvial flats bordering rivers and creeks. It is productive, and much prized by cattlemen. The name "sugar-grass" is applied to this species on account of the sweetness of its stems and foliage. Mr. Fred Turner recommends it for cultivation on good land, especially in grazing districts, and he speaks of it as being a good grass to plant on the banks of rivers, creeks, and dams, as its strong, penetrating roots would help to bind the soil and prevent its being washed away by heavy rains or floods. This grass is classed as a variety of *Pollinia cummingii* Nees, by Hackel.

No. 212. Puccinellia maritima (Huds.) Parl. Sea Spear-grass.

A slender grass, 12 to 18 inches high, with creeping rhizomes. It occurs in the marshes along the seacoasts of New England and the Middle States, and forms a valuable element of the hay of tide-water marshes.

No. 213. Redfieldia flexuosa (Thurb.) Vasey. Redfield's-grass. (Fig. 77.)

A stout, native perennial, 18 inches to 4 feet high, with long, narrow leaves and diffusely spreading panicles, growing in the sandy districts of Nebraska, Colorado, and Kansas. It has deeply penetrating and widely spreading underground stems or rhizomes, making it a valuable species for binding drifting sands. It is a characteristic grass of the sand hills of central Nebraska, growing in the drifting sands and "blow-outs," and is a conspicuous and almost the only grass found on the sand dunes south of the Arkansas River, near Garden City, Kans.

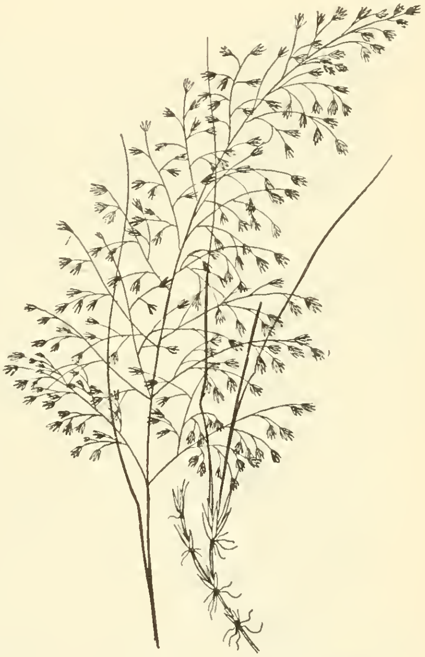


FIG. 77.—Redfield's-grass (*Redfieldia flexuosa*).

No. 214. Saccharum ciliare Anderss.

A tall, handsome grass of India, with smooth stems, 8 to 10 feet high, long leaves, and large, showy panicles of silky-hairy flowers. Used in the manufacture of matting, rope, and paper, and for thatching. The stems are made into sieves, screens, and baskets. The thicker portion of the stems is used for lining wells, and in making chairs and couches. The leaves are sometimes used for fodder, and when young the grass is grazed by cattle.

No. 215. Saccharum officinarum L. Sugar Cane.

A stout grass with many-jointed stems, 8 to 15 feet high, broad leaves, 3 to 4 feet long, and long (16 to 32 inches), pyramidal panicles. Native country unknown, but sparingly spontaneous in the South Sea Islands, where it blossoms freely. Cultivated in all tropical countries. Propagated chiefly by cuttings of the stems. There are many varieties, distinguished chiefly by the color and height of stem. The leaves are sometimes used for fodder, and, to a limited extent, also in paper making. The cane is cultivated, however, for its sweet juice, which yields from 12 to 20 per cent sugar. Under favorable circumstances an acre of ground will produce about 20 tons of cane. In this country the production of cane sugar on a commercial scale is practically limited to the States of Louisiana and Texas. The sugar production in Louisiana in 1889 was 292,124,050 pounds. The world's production of cane sugar was then about 3,000,000 tons, more than one-third of which was produced by the West Indies. Molasses is a product of sugar cane (the uncrystallizable sugar), and rum is made from molasses. Refuse cane, from which the juice has been expressed, yields a strong fiber, and in parts of India is used for torches, etc.

No. 216. Savastana odorata (Linn.) Scribn. Vanilla-grass. (Fig. 78.)

A rather slender, sweet-scented perennial, 1 to 2 feet high, with short culm leaves and brownish panicles. Moist meadows and mountains of the Northeastern States, extending westward to Oregon. This grass, remarkable for its fragrance, has long, creeping rhizomes, from which spring the flowering culms and numerous long-leafed sterile or flowerless shoots. These long leaves are woven into small mats and boxes by the Indians, and find a ready market because of the sweet odor, which they retain for a long time. This odor resembles that of sweet vernal grass, but is more powerful, especially when this grass is dry. In some European countries it is believed to have a tendency to induce sleep, and bunches of it are hung over beds for this purpose. It makes a good turf, but is of little value for forage. In the Northwest Vanilla-grass is generally called Sweet-grass.

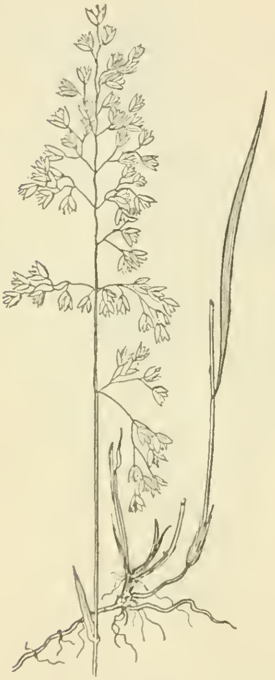


Fig. 78.—Vanilla-grass (*Savastana odorata*).

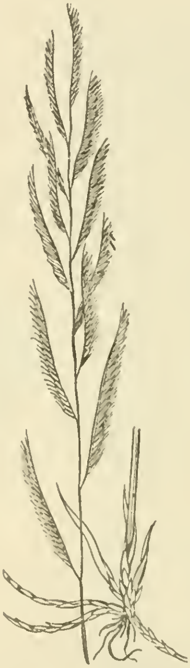


Fig. 79.—Cord grass (*Spartina cynosuroides*).

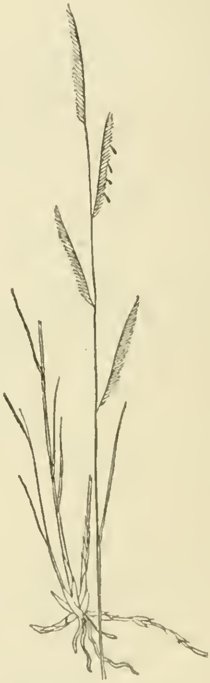


Fig. 80.—Fox-grass (*Spartina patens*).

No. 217. Secale cereale Linn. Rye.

An annual, 4 to 6 feet high, with flat leaves and a terminal, somewhat flattened, bearded spike 1 to 6 inches long. The rye crop of the United States in 1895 was 27,210,070 bushels, nearly half of which was produced in the States of

Pennsylvania, New York, and Wisconsin. Rye is more largely cultivated in central and northern Europe than in America; the grain is there very largely used for making bread. It is comparatively little used in this country for that purpose, being chiefly employed in the manufacture of malt and spirituous liquors. The straw, which is longer than that of other grains, and more uniform in size throughout, is employed in the making of a great variety of articles, such as paper, hats, bonnets, mats, slippers, toys, and fancy articles. Rye straw is little valued for fodder, but when green it is esteemed as a forage plant, and is sometimes sown for this purpose in the Southern States, cattle being allowed to graze on it during the fall and winter months. For winter grazing it should be sown upon well-prepared land early in August, when it will be ready to pasture or to cut green in the latter part of October, and may be grazed throughout the winter months.

No. 218. Spartina cynosuroides (Linn.) Willd. Cord-grass. (Fig. 79.)

Stout, with erect, simple stems 2 to 9 feet high, flat and long-pointed leaves, and numerous erect or spreading spikes 2 to 5 inches long. This is a native, common along our ocean and lake shores, borders of rivers, etc., ranging from Maine to the Carolinas, and westward to the Pacific. It makes a fair but rather coarse hay when cut early, and has been successfully employed in the manufacture of twine and paper. The strong, creeping, scaly rootstocks of this grass adapt it for binding loose sands and river banks, and in the West it is used for thatch.

No. 219. Spartina patens (Ait.) Muhl. Fox-grass. (Fig. 80.)

A rather slender species, 1 to 2 (rarely 3 to 4) feet high, with two to four slender, erect, or widely spreading spikes. This is common upon the salt marshes, and is one of the most valued species which go to form the salt hay that these marshes produce. It ranges from Maine southward to Florida and along the Gulf coast to Texas. It is useful for packing glassware, crockery, etc., and in the larger towns along the coast is much used for this purpose. Fox-grass and Black-grass (*Juncus gerardi*) are regarded as the best of the grasses of the salt marshes for the production of hay, and chemical analyses have proved the correctness of this opinion. Salt hay, composed chiefly of these grasses, at average market prices is decidedly cheaper than timothy hay.

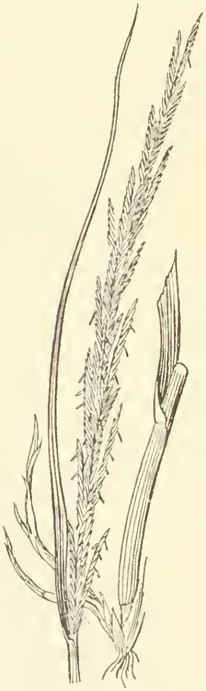


FIG. 81.—Creek-sedge (*Spartina stricta maritima*)

No. 220. Spartina stricta maritima (Walt.) Scribn. Creek-sedge. (Fig. 81.)

An erect and often stout salt marsh grass, with flat leaves, and few to many erect spikes. It varies a good deal in size, the larger form attaining a height of 5 to 8 feet. It grows along the ditches and creeks of the marshes, and is conspicuous by its size and long, shining leaves, which are of a deep green color. Smaller forms are found over the marshes away from the ditches, and these often are of a pale-green tint, with comparatively short and shining leaves. All the forms are somewhat succulent and have a rank odor, which is imparted to the milk and butter of cows feeding upon them. The species is of little value for fodder, but makes excellent thatch, and is used to some extent for litter and mulching. This is a characteristic grass of the salt marshes, and is found along both the Atlantic and Pacific coasts of our country and on the shores of Europe.

No. 221. Spinifex hirsutus Labill. Spiny Rolling-grass. (Fig. 82.)

A sand binder of the coasts of Australia, New Zealand, and Tasmania. It has stout, creeping stems, rooting at the joints, and sending up coarse, leafy tufts. The whole plant is clothed with soft hairs. The male and female flowers are borne on separate plants, the latter in globular heads, which fall off at maturity and are driven over the sands by the winds, dropping their seeds as they roll along, or are carried about by the waves and deposited on newly formed sand bars, there to continue the embanking process. It has no value for forage, but in New South Wales is regarded a most useful grass for fixing drift sands when encroaching upon valuable lands. It is readily propagated by cuttings or joints of the stems, is of comparatively quick growth, and is very persistent when once established. It would doubtless be of some value on our own Southern and Californian coasts as a sand binder.

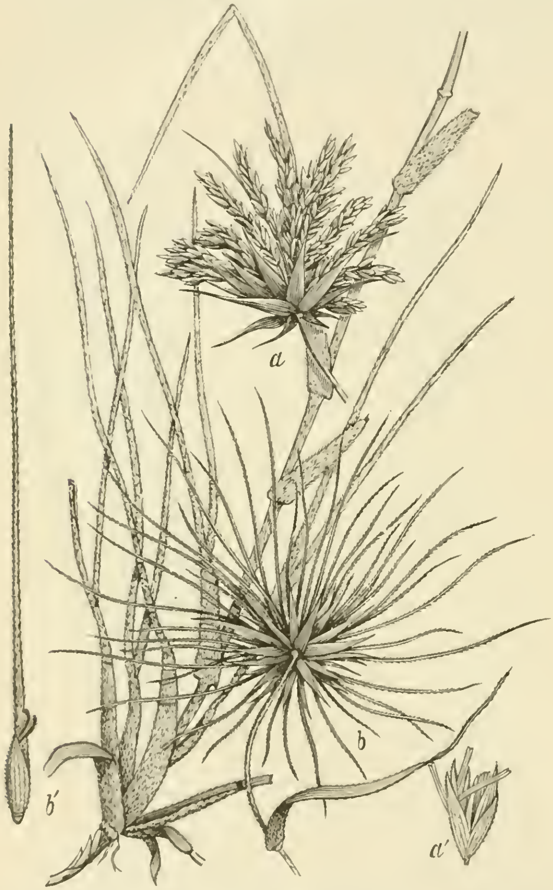


Fig. 82.—Spiny Rolling-grass (*Spinifex hirsutus*): *a*, male inflorescence; *b*, female inflorescence; *a′*, male spikelet; *b′*, female spikelet.

No. 222. Sporobolus airoides Torr. Alkali Saccaton. (Fig. 83.)

A stout rather coarse and rigid grass, growing on tussocks in sandy and more or less alkaline or saline soils along rivers and streams, ranging from Montana southward to Texas and westward to California. It has a widely spreading panicle, more open than saccaton, and the grass rarely exceeds 2 feet in height. In some places in Nevada, Utah, and New Mexico it occurs abundantly, and yields a coarse fodder, which is eaten by stock when more tender grasses are not available.

No. 223. Sporobolus asperifolius (Nees and Mey.) Thurb. Fine-top Salt-grass.

A low, somewhat creeping grass, 6 to 15 inches high, with numerous short, spreading, acute leaves, and an expanded capillary panicle 3 to 5 inches long. It grows on alkaline plains from Texas northwest to British Columbia, in similar situations as *Distichlis spicata*, and like that species often forms a dense, continuous turf. It grows well on strongly alkaline soil, and may prove valuable for propagation on such lands.

No. 224. Sporobolus cryptandrus (Torr.) A. Gray. Dropseed.

A strongly rooted perennial, 2 to 3 feet high, with usually narrow, rather densely flowered panicles, which are generally partially inclosed within the upper leaf-sheath. Common on the Western plains and in the Rocky Mountain region. It is a tender species, apparently well liked by stock, and where it occurs abundantly is very generally regarded as an important forage plant. In northern central Kansas it is spoken of as one of the best early grasses, and the same is said of it in Young County, Texas.

No. 225. Sporobolus indicus (Linn.) R. Br. Smut-grass. (Fig. 84.)

A tufted, wiry, erect perennial, 1 to 3 feet high, with narrow, densely flowered, spike-like panicles 4 to 12 inches long. This grass is widely distributed throughout the warmer temperate regions of the world, and has become quite common in many parts of the Southern States, growing in scattered tufts or patches about dwellings and in dry, open fields. As the season advances, the long, slender panicles often become overgrown by fungus, so that they appear as if attacked by smut; hence the common name "Smut-grass." By some it is looked upon as valuable for forage, but the stems soon become too tough and wiry to be readily eaten by stock, and in fields where this grass occurs it is usually avoided by cattle when other food can be had.

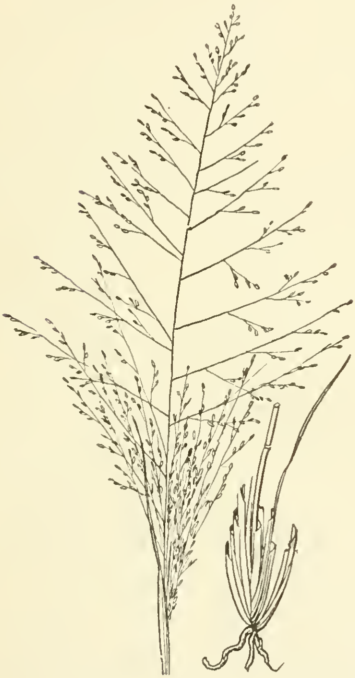


Fig. 83.—Alkali Saccaton (*Sporobolus airoides*).

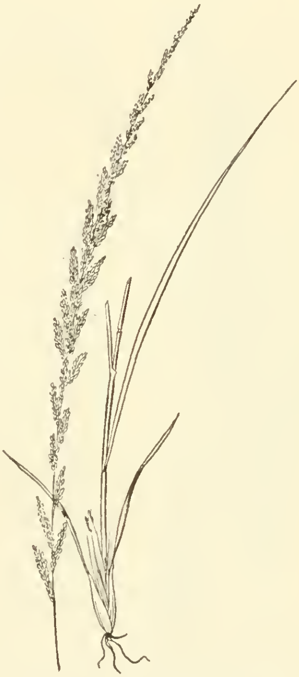


Fig. 84.—Smut-grass (*Sporobolus indicus*).

No. 226. Sporobolus junceus (Michx.) Kunth. Rush-grass.

Common in the dry, pine-barren regions of the Southeastern States. It grows to the height of 18 inches to 2 feet, and is of little or no agricultural value. This and *Aristida stricta* are known throughout the South as "Wire-grass."

No. 227. Sporobolus orientalis Kth. Usar-grass.

A wiry, creeping perennial, with rather short, rigid leaves and diffuse panicles. It is a native of India, growing upon saline soils, often constituting the entire vegetation of the extensive "usar" tracts of northern India. A valuable grass for alkaline or saline soils, yielding a liberal supply of fodder where other plants are unable to exist.

No. 228. Sporobolus wrightii Munro. **Saccaton.** (Fig. 85.)

A stout, erect perennial, 4 to 8 feet high, with long, narrow leaves and a slightly spreading panicle 12 to 36 inches long. It grows in great clumps, producing a large quantity of coarse, tough stems and leaves, which, however, in the regions where this grass is native—Arizona and New Mexico—yield a hay which is valued for horses and mules. As a hardy perennial for saline bottoms subject to flooding or incapable of cultivation, this species deserves notice. The Indians and Mexicans of Arizona and Lower California call all hay grasses "zacate," without any distinction between the species.

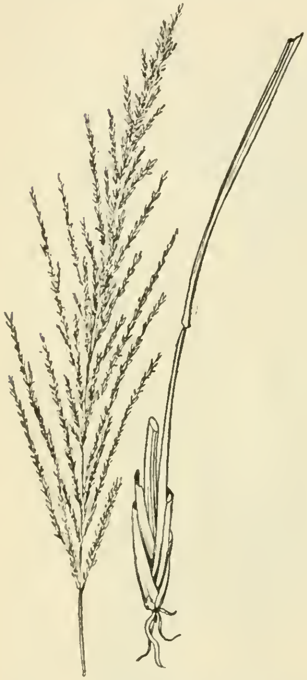


Fig. 85.—Saccaton (*Sporobolus wrightii*).

No. 229. Stenotaphrum dimidiatum (Linn.) Brongn. St. Augustine-grass. (Fig. 86.)

This grass has a wide distribution, being found in the tropical and warmer temperate regions of both the Old and New World. In New South Wales it is known as Buffalo-grass, and in Jamaica it is called Pimento-grass. It grows upon every variety of soil, from the apparently sterile sand dunes to heavy clays, but is rarely found far away from the coast. The flattened stems emit fibrous roots at every joint, where they also readily separate, each piece becoming a new center of growth. The leaves are flat or simply folded, blunt or obtuse at the apex, nearly one-fourth of an inch broad and 4 to 10 inches long. The flowering stems grow to the height of 6 inches to a foot or more. St. Augustine-grass grows along our ocean shores as far north as South Carolina, and is extensively used for lawns in Charleston, S. C., and cities in the South near the coast. It is useful for holding sloping embankments, especially those subject to wash. It is propagated by cuttings or sets, and quickly covers the most sandy yards with a dense, carpet-like growth. In South America the creeping stems are employed in medicine as a diuretic. This is the Buffalo-grass of Australia, and other local names in this country are Mission-grass and Charleston Lawn-grass.

No. 230. Stipa comata Trin. & Rupr. Needle-and-Thread.

This is one of the bunch grasses common in the Rocky Mountain region, growing on the dry mesas and foothills. It is a rather stout, leafy perennial, 1 to 3 feet high, with a panicle usually partly inclosed in the upper leaf sheath; the slender awns of the spikelets are 4 to 6 inches long and flexuose. This grass has some value, affording forage of good quality in the regions where it grows abundantly. In Dakota, Wyoming, etc., it is valued as a hay grass.

No. 231. Stipa elegantissima Labill.

A native of Australia, with erect, branching stems 2 to 3 feet high, narrow leaves, and loose panicles 6 to 8 inches long. The axis and long, thread-like branches of the panicle are elegantly plumose with fine, spreading hairs, rendering it highly ornamental. Cultivated in gardens.

No. 232. Stipa leucotricha Trin. & Rupr. Bearded Mesquite.

An erect perennial, 1 to 3 feet high, with very narrow leaves and a loose panicle with a few long-awned spikelets. One of the best native hay grasses of central and southern Texas.

No. 233. Stipa pennata Linn. Feather-grass.

A native of southern Europe, 1 to 2 feet high, growing in dry, open ground, and often cultivated in gardens as an ornamental, the very long, slender awns being clothed with spreading, silky hairs, presenting a very graceful plume-like appearance. A variety of this grass (*Stipa pennata neo-mexicana*) grows wild in the mountain regions of western Texas and Arizona. It is an elegant form of the species, growing in clumps 6 to 12 inches in diameter, and is deserving the attention of the florist.

No. 234. Stipa setigera Presl. Bear-grass.

A native of California, extending northward to Oregon and eastward through New Mexico and Arizona to Texas. It is common on the coast ranges and on the foothills of the Sierra Nevada, where it is regarded as one of the most valuable of the native bunch grasses.

No. 235. Stipa spartea Trin. Porcupine-grass.

Rather stout, 18 inches to 3 feet high, with long leaves and few-flowered panicles. The stout and twisted awns are 3 to 6 inches long, and at the base of the flowering glume is a long and very sharp-pointed callus. When mature, the awned flowering glumes soon fall off, leaving the large, pale, straw-colored, persistent empty glumes, which impart to the panicle a characteristic oat-like appearance. The awns, when dry, are bent and very strongly twisted, but when moistened they gradually untwist, a character which enables the seeds to bury themselves in the ground, this being possible on account of the very sharp callus at the base of the fruiting glume. The same character also renders the seeds of this grass dangerous to sheep, as they readily become attached to the wool, and may penetrate the flesh of the animal, causing serious injury. Aside from this danger of affecting the quality of the wool, and possibly the life of the sheep, this grass may be considered a good forage plant, as it makes a very good hay, although somewhat coarse. It is particularly common in the prairie regions of Iowa, Nebraska, South Dakota, and Minnesota, extending westward to the Rocky Mountains, where it frequently occurs upon the dry foothills and bench lands. This is the Buffalo-grass of the Saskatchewan region. In some localities it is known as Needle-grass, but that name is reserved for *Aristida fasciculata*. It is also known as "wild oats" in North Dakota.

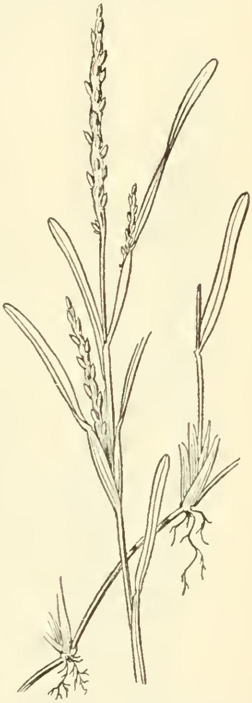


Fig. 86.—St. Augustine-grass (*Stenotaphrum dimidiatum*).

No. 236. Stipa tenacissima Linn. Esparto.

A native of the sandy regions of southwestern Europe and northern Africa. It is a tall perennial, with long, stiff, and very tough leaves, from which ropes, baskets, mats, hats, and other articles are woven. The leaves are employed largely in England and this country in the manufacture of paper, for which purpose this grass is superior to straw. It is one of the most important articles of export from Algeria, and from northern Africa and Spain more than 2,000 tons of Esparto are exported to Great Britain annually. "Ten tons of dry Esparto, worth from $18 to $25 per ton, can be obtained from an acre under favorable circumstances."

The grass will grow on almost any kind of soil, from that which is poor and sandy or gravelly to heavy calcareous and clayey soils. It thrives in the dry and hot climates of northern Africa, where many millions of acres are covered almost exclusively with it. This grass is extensively cultivated in the south of France, and possibly its introduction into some of our Southwestern districts may render profitable, regions now practically worthless. It may be propagated by seeds or by divisions of the root. The latter is the more common method. This and *Lygeum spartum* constitute the Esparto of commerce.

No. 237. Stipa vaseyi Scribn. Sleepy-grass.

A stout bunch-grass 3 to 5 feet high, which grows in the Rocky Mountains at an altitude of from 5,000 to 6,000 feet. This grass, although producing a large bulk of stems and leaves, is regarded with suspicion by stockmen. It is said that when this grass is eaten in a fresh state by horses it has a narcotic or poisonous effect, causing the animals to become crazed or "locoed," its action thus resembling that of the deadly loco weed (*Astragalus mollissimus*). Hay made from this grass does not apparently possess any poisonous qualities.

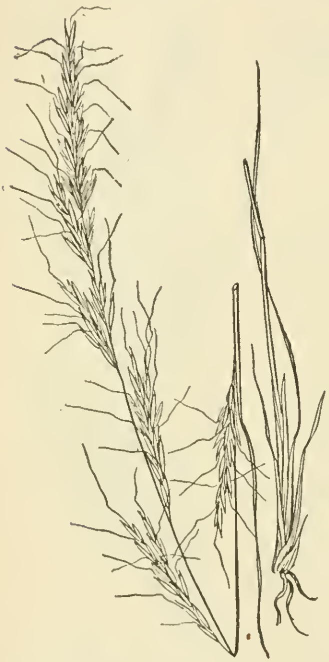


Fig. 87.—Feather Bunch-grass (*Stipa viridula*).

No. 238. Stipa viridula Trin. Feather Bunch-grass. (Fig. 87.)

A rather slender grass, 1 to 3 feet high, growing in the Rocky Mountain region and on the foothills and mesas, from British Columbia southward to Mexico and westward to the coast On good land, under irrigation, this grass attains the height of 3 feet or more, and is by far the most valuable of the Stipas for hay. The leafy culms are terminated by a narrow, many-flowered panicle of comparatively small and rather short-awned spikelets. The seed may be easily gathered. The callus at the base of the fruiting glume is short and barely pointed and not produced into a long, very sharp, spur-like extension, as in Porcupine-grass.

No. 239. Thuarea sarmentosa Pers.

A low, extensively creeping grass, rooting at the joints, with ascending flowering branches, short leaves, and slender spikes about an inch long. A native of Ceylon, northern Australia, etc., growing on the sands of the coast. It is a tender grass, and may be useful in binding coast sands in tropical countries or in the formation of lawns.

No. 240. Trichloris blanchardiana Scribn.

A perennial, 1½ to 3 feet high, with flat leaves, and six to eighteen slender, bearded spikes, which are 2 to 5 inches long, digitate or fasciculate at the apex of the culm. It has long been known to florists under the name of *Chloropsis blanchardiana*, and is esteemed as an ornamental grass, its attractive appearance making it worthy of attention. It grows in Arizona and Mexico, extending into South America.

No. 241. Tricholæna rosea Nees.

A South African annual (?), with diffusely branching stems 2 to 4 feet high. The spikelets are in loose panicles, and clothed with reddish, silky hairs. It presents a pleasing appearance when in flower, and the panicles are valued for dry bouquets. It has recently received some attention by agriculturists on account of its very vigorous rapid growth and productiveness. Experiments made in this country and elsewhere indicate that it possesses much value as a meadow or hay grass in mild climates. Three hundred stems have been counted on a single plant. These stems take root wherever they touch the ground, and an acre has been calculated to yield 30 tons of green fodder in the rich valleys of the Macleay River, New South Wales. It is easily propagated by seed.

No. 242. Triodia exigua Kirk.

A little alpine grass, endemic in New Zealand. It forms even plots of turf, often many square yards in extent; the leaves are firm, short, and shining; the compact growth of the turf or sward prevents the encroachment of other grasses or weeds. It is particularly to be recommended for croquet lawns, never requiring mowing (Kirk). In the mountain regions of the West are several of these small turf-forming grasses, which would, if cultivated, make excellent carpet-like lawns in the region of the Northern and Middle States.

No. 243. Triodia seslerioides (Michx.) Benth. Fall Redtop.

A stout, erect, native perennial, 3 to 5 feet high, with long, flat leaves and an ample, spreading, usually purple panicle 6 to 12 inches long, growing in dry or sandy fields from southern New York southward and westward to Missouri, blooming in August and September. It is a striking grass, and often covers considerable areas, but is apparently not liked by stock, and is not recognized as possessing any agricultural value.

No. 244. Tripsacum dactyloides Linn. Gama-grass. (Fig. 88.)

A tall, coarse perennial, 3 to 8 feet high, growing in large tufts, and producing a great mass of broad leaves, which when young and succulent are eaten with avidity by all kinds of stock. When abundant it affords a large amount of natural forage, and is valuable to this extent. It has very strong, creeping rootstocks, and the quantity of forage produced is large and of excellent quality. The grass may be deserving of cultivation for forage under certain conditions, and it makes an interesting and attractive plant for lawn decoration or the garden. A rich and rather moist soil is best suited to it.

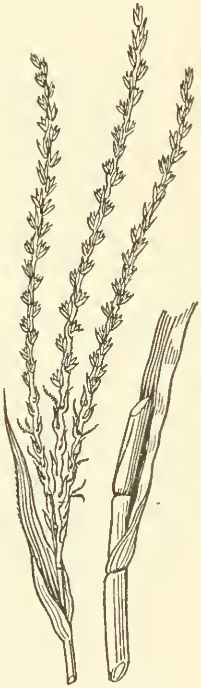


FIG. 88.—Gama-grass (*Tripsacum dactyloides*).

No. 245. Trisetum pratense Pers. Yellow Oat-grass.

A rather slender, loosely tufted perennial, growing to the height of 2 feet. It is a native of Europe, northern Africa, and western Asia. It occurs along roadsides, in open fields, and on grassy mountain slopes, where its presence is said to indicate land of good quality. In Europe, Yellow Oat-grass is classed with the best fodder plants and is highly valued for temporary, but more particularly for permanent pastures. It can be grown on almost every variety of soil, is fairly productive, and is readily eaten by stock. This grass has a record of yielding on clayey loam soils 8,167 pounds green grass, 2,858 of hay, and 4,083 of aftermath per acre. In this country it has received little attention. It is quoted in New York seed catalogues, the price ranging from $70 to $115 per 100 pounds. Sown only in mixtures.

No. 246. Triticum æstivum Linn. Wheat.

Wheat in its many varieties is one of the most important of the true grasses. It is one of the oldest of the cultivated cereals, the grains having been found in very ancient Egyptian monuments, dating back to 2,500 or 3,000 B. C. The numerous varieties are distinguished by the firmness of the axis of the spike (continuous), or its brittleness (articulated); by the presence or absence of awns or beard; by the color of the chaff, and color and size of the grain. *Triticum æstivum speltum*, of which there are a number of subvarieties, is one of the oldest grains, and was everywhere cultivated throughout the Roman Empire, forming the chief grain of Egypt and Greece. It is still grown to some extent in parts of Europe, notably in northern Spain and southern Germany. In 1895 the wheat crop of the United States was placed at 467,102,947 bushels, while the wheat crop of the world is estimated at 2,400,000,000 bushels. For a discussion of the classification of the varieties of wheat, see Hackel's True Grasses (English translation), and the Fourth Annual Report of the New York Agricultural Experiment Station, 1885.

No. 247. Triticum polonicum Linn. Wild-goose Wheat.

A very striking species or variety of wheat, with large, compressed, and usually bluish-green spikes or heads. The native country of this *Triticum* is not known, but it probably originated in Spain, where it is now cultivated to a considerable extent. It is also cultivated more or less in Italy and Abyssinia. The long and slender fruit resembles rye, but is on the whole larger. It has sometimes been advertised by seed dealers and sold to farmers under the name of Giant Rye. It is inferior to many other varieties, for, although the heads present a fine appearance, the production of kernels is small; consequently the yield of grain is light.

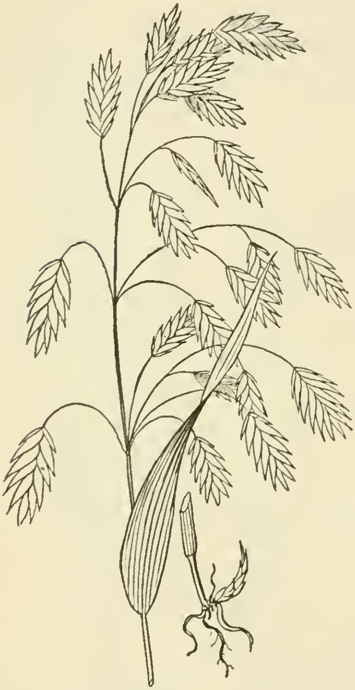


FIG. 89.—Broad-leafed Spike-grass (*Uniola latifolia*).

No. 248. Uniola latifolia Michx. Broad-leafed Spike-grass. (Fig. 89.)

Erect, with rather stout, leafy stems 2 to 4 feet high, and drooping panicles of large, flat spikelets. The leaves are broad and widely spreading, and these, together with the graceful, nodding, open panicles, render it pleasing in appearance and worthy of cultivation for ornament. It has very strong, creeping roots, and is found chiefly along streams and thicket borders from Pennsylvania southward and westward to Illinois. A grass of little or no agricultural value.

No. 249. Uniola paniculata Linn. Seaside Oats.

A native, with stout, erect stems 3 to 5 feet high, long, rigid leaves, and showy nodding panicles of broad, pale straw-colored spikelets. The panicles are gathered for dry bouquets, and are often seen in our markets, along with the plumes of Pampas-grass. It grows in the drifting sands along the seashore, just above high tide, from Virginia southward to Florida, and along the Gulf Coast westward to Texas. It is an excellent sand binder, its rootstocks being very strong and penetrating deeply into the soil, much like those of Beach or Marram grass, of which it is a southern analogue. The leaves are sometimes cropped by cattle, but the grass is too tough and dry to be of any importance as a forage plant. *Uniola condensata* of similar habit of growth, but with more densely flowered panicles, is found in the sands along the coast of Lower California.

No. 250. Zea mays Linn. Indian Corn or Maize.

One of the most valued of the cultivated cereals. The many varieties which have originated in cultivation have been variously classified. They differ much in size, in the form, size, color, and hardiness of the grain, and in the time required for ripening. Husk Maize, in which the kernels are separately enveloped in broad, herbaceous glumes, may approach the native form, which doubtless had its origin in tropical America. *Mais de coyote,* regarded by some as a distinct species, is said to grow wild in some parts of Mexico. The stems of this variety are branched above, and the numerous small ears are borne in the upper leaf axils all along the branches. The kernels are rounded and depressed, or conical with a rather acute apex pointing forward in two opposite rows, or irregularly arranged in four to six rows. Aside from its great value as a cereal, ordinary field corn is the best of the annual forage plants for soiling, and is also valued and used by many farmers for ensilage, being cut for this purpose when the kernels commence to glaze. Among the many uses of corn may be mentioned that of making cakes and corn bread, mush or hasty pudding, which is boiled corn meal, a very common dish in New England; mixed with rye and wheat flour the corn meal is used in making "brown bread"; green corn, boiled or roasted, is very largely eaten in its season, and canned corn is an important article of food; pickled green corn also is a favorite dish with many; hulled corn, or hominy, prepared by soaking the ripe grain in lye for a certain length of time and then removing the hulls or covering of the kernels, is a favorite dish in New England; popped corn, obtained by shaking the shelled corn of certain varieties in a suitable dish over live coals or a hot stove, is a luxury with children, and mixed with sugar or sirup is made into corn balls and various kinds of candy; corn and corn meal are largely fed to farm stock in this country, particularly to cattle and hogs; alcoholic liquors in immense quantities are distilled from the grain; corn husks (the leaves covering the ears) are used in making paper, in upholstery, and for filling mattresses. The total corn crop of the United States for the year 1895 was 2,151,138,580 bushels, valued at $544,985,534. The largest crop of any one State for that year was produced by Iowa, and amounted to 298,502,650 bushels.

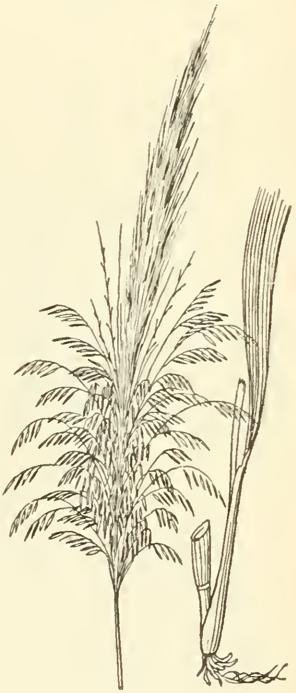


FIG. 90.—Wild Rice (*Zizania aquatica*).

No. 251. Zizania aquatica Linn. Wild Rice. (Fig. 90.)

A tall, erect annual, 3 to 10 feet high, growing in shallow water along rivers and lakes from Canada southward to Florida and westward to Texas. The grain is a favorite food of the reed bird, and the grass is cultivated to some extent by sportsmen with a view to attracting these and aquatic fowl. It grows very rapidly in 1 to 8 feet of water, and matures its seeds in August or early in September. It succeeds best when sown in the fall broadcast in 2 or 3 feet of water having a muddy bottom, but it can be sown in the spring in water from 6 inches to 5 feet deep. Before sowing soak the seeds in water twenty-four hours. Current retail price of the seeds is 25 cents per pound. This grass is abundant in the tide waters of the rivers of the Middle States, notably in the Delaware below Philadelphia, where it is always designated as "the reeds." The stems are used by coopers for making the joints of barrels intended to hold whisky or petroleum perfectly tight. This grass is the *Manorrin* of the Chippewa Indians, who gather the grain for food.

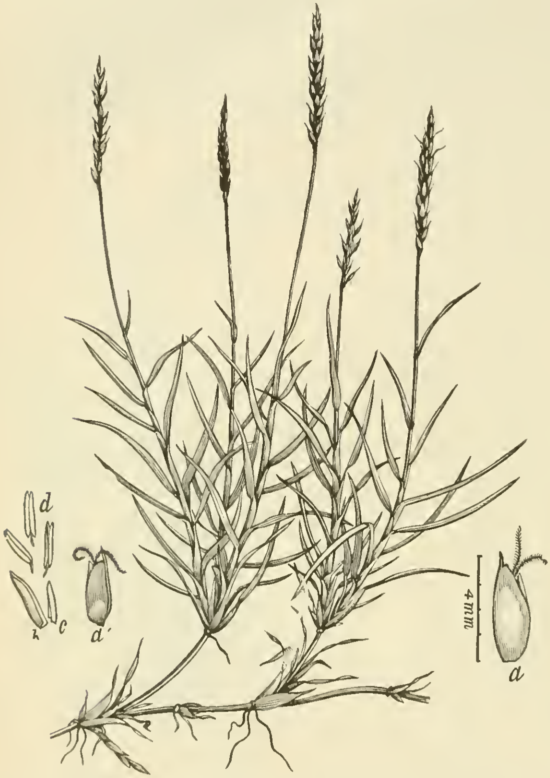


Fig. 91.—Japanese Lawn-grass (*Zoysia pungens*); *a* to *d* details of the spikelet.

No. 252. Zoysia pungens Willd. Japanese Lawn-grass. (Fig. 91.)

A creeping maritime grass growing on the sandy shores of tropical and eastern Asia, Australia, and New Zealand. In Australia it is considered an excellent sand-binder, and, while valuable for this purpose, it is at the same time an excellent forage plant. Under favorable circumstances it forms a compact turf and affords a large amount of choice pasturage. Constant cropping appears to improve it and increase the density of the turf. In the foreign settlements of China and Japan it is prized as a lawn grass, especially for tennis courts. It is finer-leafed than St. Augustine-grass, and may prove superior to that for lawns in the Southern and Gulf States. The habit of growth of Japanese lawn-grass is very similar to that of Bermuda, but the creeping stems are rather stouter and more rigid and the upright branches or tufts of flowering stems are never so tall, rarely exceeding 6 inches. It may be propagated by root cuttings or by seed. Importations of both roots and seeds from Korea have been successfully grown here, and the grass has proved hardy as far north as Connecticut. The leaves turn brown in the autumn, as do those of Bermuda.

GRASSES FOR SPECIAL SOILS OR USES.

The following lists include the best known and most valuable of the economic grasses. Descriptions of the species enumerated will be found in the body of the work under the initial letter of the Latin name. Seeds or roots of nearly all can be obtained from seedsmen.

HAY GRASSES.

Slender wheat grass (*Agropyron tenerum*), redtop or herd's grass (*Agrostis alba* and *A. vulgaris*), meadow foxtail (*Alopecurus pratensis*), Johnson grass (*Andropogon halepensis*), big blue stem (*Andropogon provincialis*), sorghum (*Andropogon sorghum*), tall oat grass (*Arrhenatherum elatius*), Mitchell grass (*Astrebla pectinacea*), oats (*Avena sativa*), side-oats grama (*Bouteloua curtipendula*), Japanese wheat grass (*Brachypodium japonicum*), smooth brome grass (*Bromus inermis*), millet (*Chætochloa italica*), Bermuda grass (*Cynodon dactylon*), crested dog's tail (*Cynosurus cristatus*), orchard grass (*Dactylis glomerata*), teff (*Eragrostis abyssinica*), teosinte (*Euchlæna mexicana*), tall fescue (*Festuca elatior*), barley (*Hordeum sativum*), Italian rye grass (*Lolium italicum*), perennial rye grass (*Lolium perenne*), rice (*Oryza sativa*), barnyard millet (*Panicum crus-galli*), guinea grass (*Panicum maximum*), broom-corn millet (*Panicum miliaceum*), Para grass (*Panicum molle*), crab grass (*Panicum sanguinale*), Colorado grass (*Panicum texanum*), pearl millet (*Pennisetum spicatum*), reed canary grass (*Phalaris arundinacea*), timothy (*Phleum pratense*), Kentucky blue grass (*Poa pratensis*), sugar cane (*Saccharum officinarum*), ——— (*Tricholæna rosea*), yellow oat grass (*Trisetum pratense*), wheat (*Triticum æstivum*), corn (*Zea mays*).

PASTURE GRASSES.

Wire bunch grass (*Agropyron divergens*), redtop or herd's grass (*Agrostis alba* and *A. vulgaris*), creeping bent (*Agrostis stolonifera*), bushy blue stem (*Andropogon nutans*), big blue stem (*Andropogon provincialis*), little blue stem (*Andropogon scoparius*), needle grass (*Aristida fasciculata*), Mitchell grass (*Astrebla pectinacea*), side-oats grama (*Bouteloua curtipendula*), black grama (*Bouteloua eriopoda*), blue grama (*Bouteloua oligostachya*), Japanese wheat grass (*Brachypodium japonicum*), rescue grass (*Bromus unioloides*), smooth brome (*Bromus inermis*), buffalo grass (*Bulbilis dactyloides*), windmill grass (*Chloris verticillata*), Bermuda grass (*Cynodon dactylon*), orchard grass (*Dactylis glomerata*), everlasting grass (*Eriochloa punctata*), Indian millet (*Eriocoma cuspidata*), hard fescue (*Festuca duriuscula*), tall fescue (*Festuca elatior*), sheep fescue (*Festuca ovina*), red fescue (*Festuca rubra*), curly mesquite (*Hilaria cenchroides*). perennial rye grass (*Lolium perenne*), Indian wheat (*Panicum ciliatum*), carpet grass (*Paspalum compressum*), knot grass (*Paspalum distichum*) Texas blue grass (*Poa arachnifera*), Canada blue grass (*Poa compressa*), Kentucky blue grass (*Poa pratensis*), rough-stalked meadow grass (*Poa trivialis*), rye (*Secale cereale*), St. Augustine grass (*Stenotaphrum dimidiatum*).

LAWN GRASSES.

Seacoast bent (*Agrostis coarctata*), creeping bent (*Agrostis stolonifera*), Rhode Island bent (*Agrostis canina*), buffalo grass (*Bulbilis dactyloides*), Bermuda grass (*Cynodon dactylon*), various-leafed fescue (*Festuca heterophylla*), red fescue (*Festuca rubra*), Mexican lawn grass (*Fourniera mexicana* and *Opizia stolonifera*), carpet grass (*Paspalum compressum*), wood meadow grass (*Poa nemoralis*), Kentucky blue grass (*Poa pratensis*), rough-stalked meadow grass (*Poa trivialis*), St. Augustine grass (*Stenotaphrum dimidiatum*), Japanese lawn grass (*Zoysia pungens*). (See paper on "Lawns and Lawn Making," in the Yearbook of the Department of Agriculture for 1897.)

GRASSES FOR WET LANDS.

Redtop or herd's grass (*Agrostis alba* and *A. vulgaris*), seacoast bent (*Agrostis (coarctata*), creeping bent (*Agrostis stolonifera*), cane (*Arundinaria macrosperma* and *A. tecta*), blue-joint (*Calamagrostis canadensis*), giant millet (*Chaetochloa magna*), salt grass (*Distichlis spicata*), red fescue (*Festuca rubra*), velvet grass (*Holcus lanatus*), Italian rye grass (*Lolium italicum*), rice (*Oryza sativa*), reed meadow grass (*Panicularia americana*), floating manna grass (*Panicularia fluitans*), fowl meadow grass (*Panicularia nervata*), barnyard grass (*Panicum crus-galli*), Para grass (*Panicum molle*), carpet grass (*Paspalum compressum*), knot grass (*Paspalum distichum*), reed canary grass (*Phalaris arundinacea*), timothy (*Phleum pratense*), false redtop (*Poa flava*), Kentucky blue grass (*Poa pratensis*), St. Augustine grass (*Stenotaphrum dimidiatum*), wild rice (*Zizania aquatica*).

GRASSES FOR EMBANKMENTS.

Couch grass (*Agropyron repens*), Johnson grass (*Andropogon halepensis*), vetivert (*Andropogon squarrosus*), cane (*Arundinaria macrosperma*), smooth brome (*Bromus inermis*), sand grass (*Calamovilfa longifolia*), Bermuda grass (*Cynodon dactylon*), salt grass (*Distichlis spicata*), red fescue (*Festuca rubra*), blady grass (*Imperata arundinacea*), maiden cane (*Panicum digitarioides*), vine mesquite (*Panicum obtusum*), creeping panic grass (*Panicum repens*), carpet grass (*Paspalum compressum*), knot grass (*Paspalum distichum*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites vulgaris*), cord grass (*Spartina cynosurus*), St. Augustine grass (*Stenotaphrum dimidiatum*), Japanese lawn grass (*Zoysia pungens*).

GRASSES FOR HOLDING SHIFTING SANDS.

Seacoast bent (*Agrostis coarctata*), beach grass (*Ammophila arenaria*), turkey foot (*Andropogon hallii*), sand grass (*Calamovilfa longifolia*), Bermuda grass (*Cynodon dactylon*), sea-lyme grass (*Elymus arenarius*), soft sea-lyme grass (*Elymus mollis*), Mexican salt grass (*Eragrostis obtusiflora*), blady grass (*Imperata arundinacea*), blow-out grass (*Muhlenbergia pungens*), bitter panic (*Panicum amarum*), creeping panic (*Panicum repens*), Redfield's grass (*Redfieldia flexuosa*), fox grass (*Spartina patens*), spiny rolling grass (*Spinifex hirsuta*), St. Augustine grass (*Stenotaphrum dimidiatum*), seaside oats (*Uniola paniculata*), seaside blue grass (*Poa macrantha*), Japanese lawn grass (*Zoysia pungens*). (See papers on "Grasses as Sand and Soil Binders" in the Yearbook of the Department of Agriculture for 1894, and "Sand-binding Grasses" in the Yearbook for 1898.)

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BULLETIN No. 15. Agros. 35.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF AGROSTOLOGY.
[Grass and Forage Plant Investigations.]

A REPORT

UPON THE

FORAGE PLANTS AND FORAGE RESOURCES

OF THE

GULF STATES.

BY

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PREPARED UNDER THE DIRECTION OF THE AGROSTOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., July 15, 1898.

Sir: I have the honor to transmit herewith, and recommend for publication as Bulletin No. 15 of this Division, a report by Prof. S. M. Tracy, of Mississippi, on the Forage Plants and Forage Resources of the Gulf States east of Texas. This report is in line with the investigations of the grasses and forage plants of the South now being carried on by this Division.

The grazing and forage problems in the South are of great importance; keen competition is compelling the adoption of a more diversified system of agriculture than has existed in the past. Fine cattle and good milk and butter are more profitable than cotton, and there is an increasing demand for good hay and pasture grasses and other forage crops. The climate is excellent for the growth of many kinds of grasses, and the soils are for the most part good or readily susceptible of care and cultivation.

There are between 300 and 400 species of grasses in the five Gulf States east of Texas. One observer has found in the State of Alabama alone 255 kinds. A large proportion of these grasses are unknown in the Northern and Western States, being peculiar to the Gulf coast region. This abundance of native grasses indicates that the South is naturally a good grass country, and there are wide areas in each of these States which may be profitably devoted to the formation of meadows and pastures.

The value and adaptability of these many kinds, and of foreign sorts as well, to special purposes, or to local conditions, ought to be systematically investigated. The work of determining the most practical methods of introducing and cultivating those grasses which are most likely to succeed and which will at the same time be best suited to meet the needs of the stock raisers and dairymen, has been approved by you, with instructions to this Division to begin an investigation of the grasses and forage plants and forage problems of the Gulf States. Particular attention will be given to noting the abundance and value of the native forage plants and the possible methods to be employed in maintaining or improving the existing conditions of pasturage and forage supplies. A circular letter requesting information relative to the points involved in the investigation was sent to parties interested in the work proposed, and many replies containing much valuable information bearing on the subject have been received.

In connection with the preparation of the present report, Professor Tracy made a large collection of the native Southern grasses, and furnished the Division much valuable information relative to the prevalence and distribution of the species. The data thus acquired, together with that afforded by collections in the National Herbarium, will be used in preparation of a list of the grasses of the South, while the information contained in the replies to the circular letters above referred to will be used in the compilation of a report of a more practical nature.

The illustrations for the present bulletin have been carefully selected by the Agrostologist from the drawings prepared under his supervision.

Respectfully,

F. Lamson-Scribner,
Agrostologist.

Hon. James Wilson,
Secretary of Agriculture.

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FORAGE PLANTS AND FORAGE RESOURCES OF THE GULF STATES.

INTRODUCTORY.

Until within the last fifteen years it was commonly believed that good pastures did not exist in the Gulf States of Louisiana, Mississippi, Alabama, Georgia, and Florida, and that good hay could not be made in that region. With rare exceptions the pastures used were composed of the wire grasses and broom sedges of the pine woods, and the larger part of the hay which was found on the market, even in the smaller towns, was brought from the North.

The work which has already been done by the United States Department of Agriculture, together with that of many intelligent planters, has demonstrated that the soil and climate of the Gulf States are such as will produce a heavy yield of forage, and that the quality of Southern-grown hay is fully equal to that of any which can be imported from other localities.

SOILS OF THE GULF STATES.

The soils of the Gulf States, excepting a small area in northern Alabama and Georgia, are all alluvial. They may be subdivided into six quite distinct sections with quite different types of soil. These are:

(1) The treeless prairie region of southwestern Louisiana.

This region is mostly low, intersected by numerous rivers and bayous, and the soil, a sandy loam, is of wonderful fertility.

(2) The Gulf coast region, including a narrow strip along the coast from Louisiana to Florida.

This region has a rather sandy soil, often quite light on the immediate coast, but becoming more loamy and usually underlaid with a heavy clay formation a few miles back from the beach.

(3) The pine woods region, extending from central Louisiana eastward to Georgia and northern Florida.

The soil in this region is usually a sandy, easily worked loam underlaid with clay, becoming lighter toward the South, where it merges into the alluvial soil of the coast district.

(4) The clay loam region of the upper or northern section, extending from northern Louisiana to central Georgia.

In this region the pine growth is more or less mixed with oaks, hickories, and other deciduous trees. The soil is variable, being rich and fertile along the creek bottoms, but harder, drier, and often somewhat sterile on the hills. These lands often suffer seriously from washing.

(5) The black prairie region of northeastern Mississippi and western Alabama.

The soil in this region is black, rich in lime, and affords some of the best grass lands in the South.

(6) The river bottoms.

While five of the divisions or regions named above are in irregular belts extending from west to east, all are crossed by rivers, the Red, Mississippi, Pearl, Tombigbee, Chattahoochee, and others, which flow in a southerly direction. Much of the land along these rivers is of very recent formation and is quite different from that of the neighboring hills. It is generally extremely fertile, but often suffers from overflows and for want of drainage. In each of these regions wide variations of soil may be found, and these differences occur sometimes on a single farm.

NATURAL PASTURES.

The natural forage plants vary as widely as the soils. Some adapt themselves to almost any situation and are quite general in their distribution, while others are extremely local; some become more vigorous and abundant under frequent grazing, while others soon disappear with any change of surroundings.

The natural pastures of the Gulf States are composed largely of such grasses (fig. 1) as are native to the more or less open pine woods, while along the streams and roads many foreign grasses and legumes (clovers or beggar weeds) have become thoroughly naturalized and add very materially to the value of the range. Of native forage plants not less than 350 species and varieties of grasses alone have been identified. Of that number, 25 yield fully 75 per cent of the grazing. Fully 90 per cent of the natural grazing is afforded by not more than 30 species. Of the 12 or 15 naturalized and widely distributed species the proportion of valuable sorts is much larger, as only those which are able to thrive in this soil and climate and make places for themselves on ground already occupied by native species could become established without assistance.

The best native pastures are those of the prairie region of Louisiana, where the soil is fertile, the climate favorable for an almost continuous growth, and where there are no trees to shade the ground or to appropriate the moisture and nourishment necessary for the growth of abundant and nutritious herbage. There the *Paspalums* are the characteristic and most abundant grasses, carpet-grass (*P. compressum*), large water-grass (*P. dilatatum*), smooth water-grass (*P. lentiferum*), and slender paspalum (*P. setaceum*) being the most common species on the wild prairie, while on lands which have been grazed for a considerable time carpet-grass occupies a large portion of the ground and makes a vigorous growth. Among other grasses which are abundant in this region are Munro-grass (*Panicum agrostoides*), narrow-leafed panic-grass (*P. angustifolium*), barnyard-grass (*P. crus-galli*), mutton-cane (*P. dichotomum*), sprouting crab-grass (*P. proliferum*), Colorado grass (*P. texanum*), switch-grass (*P. virgatum*), gama (*Tripsacum dactyloides*), silver-beard (*Andropogon argyræus*), Elliott's broom sedge (*A. elliottii*), big blue-stem (*A. provincialis*), little blue-stem (*A. scoparius*), sedge wire-grass (*Aristida palustris*), redtop (*Agrostis vulgaris*), and shining love-grass (*Eragrostis nitida*).

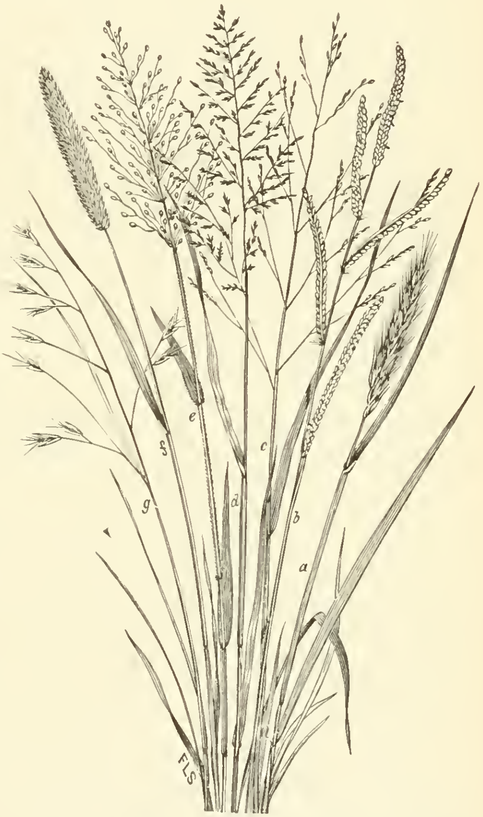

FIG. 1.—Characteristic Southern grasses. (*a*) *Elymus virginicus;* (*b*) *Paspalum ovatum;* (*c*) *Panicum virgatum;* (*d*) *Panicum agrostoides;* (*e*) *Panicum viscidum;* (*f*) *Phalaris angusta;* (*g*) *Danthonia compressa.*

The pastures of this region, unlike those of most other sections, improve under rather heavy grazing on account of the unusual abundance of water-grasses. Dr. Knapp, of Lake Charles, La., states that while the wild lands will support one cow on about three acres, old pastures will give good grazing for a cow on one acre, and he has kept two cows per acre in good condition during nine months of the year.

The natural pastures along the alluvial lands of the Red, Mississippi, and other rivers are exceedingly variable, both in quality and in variety of plants. The tree growth is usually so dense that ordinary grazing plants will not grow excepting in open places, and the cane (*Arundinaria*) is the only true grass which is able to hold its place. In many localities this forms extensive "canebrakes" which furnish, both winter and summer, grazing for thousands of cattle. Too heavy grazing soon kills the cane, and it is seldom renewed. Along the borders of streams and swamps, and wherever the sun can penetrate, Munro-grass, flat-stemmed panic-grass (*Panicum anceps*), barnyard-grass, switch-grass, many-flowered love-grass (*Eragrostis glomerata*), fall redtop (*Triodia seslerioides*), large water-grass, smooth paspalum (*Paspalum læve*), and slender paspalum, together with two or three species of vetches, add largely to the grazing. When the lands have been grazed for a considerable time the species of *Panicum*, *Eragrostis*, and *Triodia* disappear and are replaced by carpet-grass, where the soil is sufficiently sandy, and by Bermuda and redtop on heavier soils.

In the uplands of the northern pine region of Louisiana and Mississippi the sedge-grasses, wire-grasses, and panic-grasses form a large part of the natural growth. Big blue-stem, little blue-stem, and broom-sedge (*Andropogon virginicus*), branching triple-awn-grass (*Aristida dichotoma*), prairie triple-awn-grass (*A. oligantha*), purplish triple-awn-grass (*A. purpurascens*), slender paspalum, and prairie-grass (*Sporobolus asper*) are among the more common species on the hills, while along the streams large water-grass, Terrell-grass (*Elymus virginicus*), cane, and gama are more abundant. Under continued grazing many of these, especially the broom-sedges and wire or needle grasses, disappear and are largely replaced by Bermuda and lespedeza. When grazed too closely even these become so weakened that they fail to hold the ground against the worthless and aggressive bitter-weed (*Helenium autumnale*). Where the soil is rich in lime, as in the black prairie region of Mississippi and Alabama, sweet clover soon establishes itself and becomes one of the most important of the naturalized species.

Much the same conditions obtain farther to the eastward, in northern Alabama and Georgia, the wire-grasses (species of *Aristida* and *Sporobolus*) forming a large part of the natural growth; while bunch-grass (*Andropogon tener*) grows thickly on the sandy hills, and prairie-grass, rush-grass (*Sporobolus junceus*), and southern poverty-grass (*S. vaginæflorus*) are common on the more clayey soils.

In the long-leaf pine region along the Gulf coast the number of species, both of the true grasses and of other forage plants, is much larger than farther north, and as the woodlands are mostly open and with very little undergrowth, the natural pastures are better than in some other sections. Panic-grasses, water-grasses, and sedge-grasses are abundant, and several species not found in other sections assume considerable importance here. Fringe-leafed paspalum (*Paspalum ciliatifolium*), large water-grass, smooth paspalum, carpet-grass, slender paspalum, Munro-grass, flat-stemmed panic, mutton-cane, switch-grass, creeping beard-grass (*Oplismenus setarius*), smooth foxtail (*Chætochloa lævigata*), Elliott's broom-sedge, brook-grass (*A. glomeratus*), big blue stem, bunch-grass and broom-sedge, branching triple-awn-grass, slender triple-awn-grass (*Aristida gracilis*), purplish triple-awn-grass, swamp poverty-grass, Muhlenberg's hair-grass (*Muhlenbergia capillaris*), prairie-grass, rush-grass, and *Triodia ambigua* are among the more prominent species. Branching panic-grass in its several varieties, and here known as "mutton-cane," is, perhaps, the most abundant of any single species, continuing its growth throughout the entire year and furnishing the bulk of the grazing for thousands of sheep and cattle which winter in the woodlands. Continued grazing destroys many of the wire grasses, which are largely replaced by water-grasses, mutton-cane, Japan clover or lespedeza, and Bermuda.

Immediately along the coast and on the adjacent islands there are a number of conspicuously abundant species, though limited in range to the immediate vicinity of the water. Among these are bitter panic (*Panicum amarum*) and creeping panic (*P. repens*), seaside finger-grass (*Chloris petræa*), St. Augustine grass (*Stenotaphrum dimidiatum*), salt grass (*Distichlis spicata*), and creek-sedge (*Spartina stricta maritima*). In the salt marshes wild-rice millet (*Zizaniopsis miliacea*), Munro-grass, and switch-grass are abundant, while giant millet (*Chætochloa magna*) and barnyard-grass often make immense growths. Among other native forage plants abundant in this region are low killinga (*Killinga pumila*), which often covers considerable areas and is the most valuable of the sedges for summer grazing, wild bean (*Vigna glabra*), with its pea-like growth, and Florida beggar-weed (*Desmodium tortuosum*) on the more sandy soils. When the field is grazed so closely as to weaken the growth of the sedge-grasses and wire-grasses, carpet-grass takes possession of the Southern pasture.

As a whole, the native pastures of the Gulf States contain a much larger number of species than do those of the North, and so furnish excellent grazing while they last, but many of them soon become so weakened by constant grazing and trampling that they finally give place to worthless weeds or leave the ground bare, to be washed and gullied by the winter rains.

THE FORMATION OF PASTURES.

With a climate favorable to an almost continuous growth, and with soil easily worked and promptly responding to good management, it is not difficult to secure permanent pastures of the highest quality; but in order to obtain the best returns, the same intelligent care must be used in their preparation and management as are given other portions of the farm.

The best pastures are those which contain the greatest variety of plants yielding palatable food for stock. These plants should be such as make their greatest growth at different seasons, in order that there may be a continuous supply; a portion of them should be legumes, both for their superior fattening qualities and for their effect on the soil, and as large a proportion as possible should be perennials. Such a pasture can not be made in one season, but requires time for its best development, and when once secured its value and feeding capacity will increase yearly under good management.

Excellent pastures are sometimes made from the natural sod, but in most cases it is more satisfactory, and in the end less expensive, first to plow the ground and use it two or three years for corn or cotton, which will kill the wild broom-sedges and wire-grasses and change the character of the soil so that the cultivated grazing plants will be able to establish themselves so thoroughly as to prevent the growth of other and less desirable sorts. The prairie lands of Louisiana make excellent pastures without plowing, and the thin, sandy lands along the Gulf coast can be made into very satisfactory pastures simply by grazing to destroy the wire-grasses and to encourage the growth of carpet-grass. The coming in of the carpet-grass can be materially hastened by mowing an old pasture in July or August when the grass is maturing its seed and scattering the hay over the new field. Wet places should be planted with either roots or seed of the large water-grass, which grows well in such places and is especially valuable during winter. Many of the coast soils are so deficient in lime that it is difficult to secure a good growth of any of the clovers. Where the soil is not too light, lespedeza will do fairly well, and as its growth improves year after year, it pays to sow it in all pastures. On light soils which contain lime, like many of those in southern Georgia and Florida, the Florida beggar-weed grows well, reseeds itself freely, and makes good summer and fall grazing, but yields nothing during the winter and spring months. It is very little trouble to make good pastures on the coast soils which have once been in cultivation, as carpet-grass takes possession of such fields very quickly. Bermuda will cover the more fertile spots, and the sowing of lespedeza or beggar-weed will provide the best leguminous grazing plants for these soils.

Rich and moist alluvial soils, like those along the rivers and large streams, will finally become covered with a growth of Bermuda grass, but even on such lands the spread of the grass is slow, and the ground can be covered much more quickly if it is first plowed to kill the coarser growth and bring it into better mechanical condition. These soils make better pastures than do any other, as they are naturally the most fertile, most easily kept in condition, and will support a greater variety of plants. For these, as for all fertile soils, Bermuda is the best possible foundation, and should be planted as described on page 25, but as its season for good grazing lasts only six or eight months, it should have other species planted with it. Large water-grass and Terrell-grass will give good winter grazing along the water courses and in damp places, while bur-clover and lespedeza should be sown on the drier portions. Along creeks, the borders of marshes, and other wet places redtop and alsike clover should be sown at the rate of a bushel of the former and two quarts of the latter per acre. On black soils four quarts of red clover seed may be added with advantage.

On the drier and harder upland soils it is almost impossible to secure good pastures without previous cultivation of the land. The natural pastures in this region are all that can be desired during the summer and early fall, but fail quickly after the first frosts and do not become really good again until April. Here, as elsewhere, Bermuda and lespedeza are the best foundation for a pasture, as both make vigorous growths and both are permanent, although neither is of much value during winter or spring. No grazing plant has been found which will make a satisfactory winter and spring growth on the dry, hard, clay hills of this region, and such localities can be depended upon for summer and fall grazing only.

On the seepy hillsides and on the lower lands the grazing season may be greatly extended and good permanent pastures are not hard to make by the use of the same plants which have been recommended for the alluvial soils. Bur-clover does well on these soils, and in many places wild vetches are abundant, beginning their growth in the early winter and making good grazing by February or March.

On moist lime soils, especially where partially shaded, Kentucky blue grass does well, but it is of no value on the light colored or on the red clay soils. Where the soil is somewhat sandy, old fields are often made into pastures by mowing carpet-grass and scattering the hay over the knolls and hilltops in the fall, and following this with lespedeza seed in the spring. It costs but little to seed a pasture in this way, and it is often the best plan to follow. The ground is sure to be covered with a good growth of crab-grass the first year, and by the second year the carpet-grass and lespedeza will be scattered over the entire field. In the "cane-hill" region of northern Louisiana and southern Mississippi this is the more common method of making pastures. On many farms temporary pastures with annual plants in rotation with cultivated crops are more economical and satisfactory than are permanent pasture fields.

Farther eastward, on the clay uplands of Alabama and Georgia, good permanent pastures are still more difficult to secure. When the sparse natural growth of wire-grass and broom-sedges has disappeared, better grasses fail to take their places, and the land produces only a scant growth of poverty weed with a little thin fescue in early spring, with fall panic and similar grasses later in the season. The bottom lands of this section, however, make fine grazing lands and are capable of producing a great variety of plants, both true grasses and legumes. Bermuda gives the bulk of the grazing, but redtop, Canadian blue grass, lespedeza, bur-clover, and the vetches all do well. In some places Texas blue grass flourishes and makes a heavy yield for winter grazing.

Farther south, on the immediate Gulf coast and in the greater part of Florida where the growing season is practically continuous, Bermuda is largely replaced by carpet-grass, while fewer perennials and more annuals are used to add to the yield and variety. Crab-grass and Mexican clover are everywhere in cultivated fields from which the crops were removed by midsummer, and on many of the native pastures beggar-weed is the predominant growth. In the larger part of this region only a very small proportion of the land is in cultivation, so that cattle have such an abundant range in the woods that the need of permanent pastures has scarcely been felt as yet, and but little attention has been given to the cultivated grazing plants. Judge J. M. Jones, of Florida, states that on the natural ranges and in the old fields cattle will make a good gain for six months, about hold their own for three months, and will need feeding during the other three months to keep them in good condition. As the proportion of cultivated lands increases, the ranges and permanent pastures will become as important in Florida as elsewhere.

In the black prairie district of Mississippi and Alabama good pastures can be made with but little trouble by the use of Bermuda, lespedeza, and melilotus, with redtop and alsike for the wet soils.

THE ESSENTIALS OF A GOOD PASTURE.

In general, the making of a good permanent pasture is a more difficult matter in the South than in the North, as it is necessary to provide for a longer grazing season. There is no one grazing plant which continues in active growth through the entire year, and the best growth of most species is made in the course of three or four months. Some make nearly their whole growth in the early spring months, others do not begin their growth until late and continue to grow until killed by frost, while still others begin their growth with autumn rains and mature their seed in the early spring. When one species has completed its growth, or becomes dormant for a few months, others are ready to take its place at once, and so a constant succession is maintained.

SELECTION OF VARIETIES.

With such constant changes it is often difficult to select species for a mixture, each of which will hold its own without overgrowing weaker species or being crowded out by its stronger neighbors. The best plants for permanent pastures must be either perennials, or annuals which reseed the ground freely and surely. They must be adapted to soils of widely different character, their roots must be able to endure continued drought, and they must be palatable to all kinds of stock. No one species will cover and hold the ground throughout the whole year, and so it is necessary to use a mixture of several kinds, at least one of which should be a legume, and it is difficult to arrange these mixtures so that they will be suited to the widely varying Southern soils, or even to the different soils which are usually found on a single farm. Whatever may be planted will usually prove to be only the foundation of the pasture, as every locality has native or naturalized species which will finally occupy a considerable portion of the ground, and often some of these self-introduced sorts will prove as valuable as many of those which have been introduced and deliberately planted. For the whole of the Gulf States, excepting the sandy soils near the coast, Bermuda and Japan clover should be the foundation of every permanent pasture. On alluvial lands add redtop and alsike clover for the damper soils, with orchard grass, sweet clover, and bur clover for the drier lands. On the uplands, yellow loam, and clay sections, orchard grass and bur clover do well on the dry soils, while for wet places redtop, large water-grass, and alsike clover should be added. For the black prairie region Texas blue grass and sweet clover are the best additions. On the light soils of the coast region carpet grass, large water-grass, giant beggar-weed, and mutton-cane largely replace the redtop and clover of more Northern sections.

CARE OF PASTURE LANDS.

When a satisfactory permanent pasture has been secured, it needs the same care and attention which are given to other parts of the farm. Heavy fertilizing is seldom necessary, though an occasional application of cotton-seed meal and muriate of potash are profitable for stimulating a better growth on thin spots. The most common injury to pastures is that caused by being grazed too closely. When grazed so closely as to leave the surface of the ground partially exposed and to weaken the roots of the grasses, rolling lands are often seriously injured by washing. Small washes are easily stopped by driving in a few stakes and banking around them with Bermuda sods. On clay soils the presence of bitterweed is a sure indication that the land has been overpastured. It is practically impossible to destroy the weed by digging or mowing, and the best treatment for a pasture in which it has made its appearance is to fertilize liberally and graze it less heavily, when the weed will soon disappear. It is never troublesome in fertile pastures which are not overgrazed.

TEMPORARY PASTURES.

In a region where it is so difficult to secure perennials for permanent pastures, and where the growing season is so long that two or more crops can be grown on the same land yearly, temporary pastures of quick-growing annuals will always be largely used, and in many sections will afford the most economical grazing for different seasons. Fields from which oats, melons, potatoes, and other early crops have been removed make fine pastures from July until the end of summer. Cornfields in which cowpeas have been planted make the best of fall grazing, while oats and vetches make abundant and nutritious winter feed. These can be grown on land from which early crops have already been taken. They cost nothing but the seed and the sowing, and on many soils heavy volunteer crops give fine grazing for three or four months with absolutely no cost. Under such conditions temporary pastures are not makeshifts, but are an important part of a well-arranged rotation.

The most valuable plants for summer and fall grazing are crab-grass, crowfoot, Mexican clover, and Florida beggar-weed, all of which make volunteer growths so late in the season as not to interfere with other crops, and will cover and protect fields which would otherwise be idle. Crab grass is abundant everywhere in cultivated land. Crowfoot is rare in the northern and western sections, but is common southward from the beginning of the sandy pine region in Alabama and Georgia, and often covers the ground as thickly as does crab-grass in other sections. Mexican clover is abundant only near the coast, where it is usually found in fields with crab-grass, but is valued less for grazing than for hay. Beggar-weed is more abundant in Florida than elsewhere, though fields containing a mixed growth of that plant, crab-grass, and crowfoot are often seen in southern Alabama and Georgia. Beggar-weed has been sown in many localities in the coast region, but does not seem to have gained the foothold elsewhere that it has in Florida. Where it does do well it is regarded as the most valuable plant for summer and fall pastures. It is eaten by all kinds of stock and is fattening, but it is said that horses and mules can not stand hard work without other feed.

For later grazing the same plants may be used, and cowpeas and chicken corn, together with pickings from the corn and hay fields, make the fall pastures rich and varied in favorable seasons; but in seasons of severe drought they often become dry and poor, and it is in such seasons more than at any other time that silos and soiling crops are needed. Although cowpeas do not bear grazing well they make the best of feed, and are often more profitable when used for pasturage than when used in any other way. The droppings from the grazing animals are left in the field and serve to maintain the fertility of the soil. On very light or sandy soils the plowing under of the vines is less beneficial than the trampling of the stock and the addition of the manure. While it is more profitable to cut the vines for hay when grown by themselves, pasturing them is usually better when they are grown in cornfields. The fertilizing value of the crop is worth more than the cost of the seed, so that the pasturage is all clear profit. Chicken corn is more abundant in the black prairie region than elsewhere, and makes its growth late in the season after corn is nearly matured. Being a volunteer crop, it costs nothing and is worth nearly or quite as much as sorghum for grazing purposes. A good grazing plant which will bear the autumn drought without injury would be a great boon to the Southern stock raiser.

WINTER PASTURES.

For winter grazing, oats, rye, barley, and hairy vetch are the most successful crops, and a mixture of "turf oats" and hairy vetch has given more satisfactory results than has any other winter-grazing crop which has been tested. The turf oats are more hardy than are most other varieties, never having been injured by cold in central Mississippi or Alabama. They stool very freely, often sending up 100 or more stems from a single root, and they bear close and long-continued grazing without injury. For winter grazing they should be sown as early as October, though December sowing may be made for early spring feed.

These oats ripen later than do other varieties, and the yield of grain is about the same. Ordinarily they are entirely free from rust, though when on low and wet ground they sometimes suffer from that disease. The vetch grows best on a rich and heavy soil, does fairly well on rather thin clay lands, but is worthless on light soils. When sown with turf oats, it makes but little show in early winter, but from January onward it nearly doubles the amount of grazing and does not interfere with the growth of the oats. Mr. E. R. Lloyd, the agriculturist of the Mississippi experiment station, says: "This is the best combination I have ever seen for winter grazing, and our farmers are beginning to realize its value. On the bottom land where we grew the mixture last year we grew a crop of peas during the summer, with a view to killing out the Johnson grass. This fall there is very little of the Johnson grass to be seen, while the oats and vetch came up well after the first fall of rain, without reseeding. The field is now (November 14) very green and would make fine grazing." On good soils the mixture may be grazed from November to March, when, if the stock be taken off, it will make fully a ton of fine hay per acre by the last of May. If grazed continuously until June, it will usually reseed the ground sufficiently for a crop the following season, though the volunteer oat crop is rather uncertain.

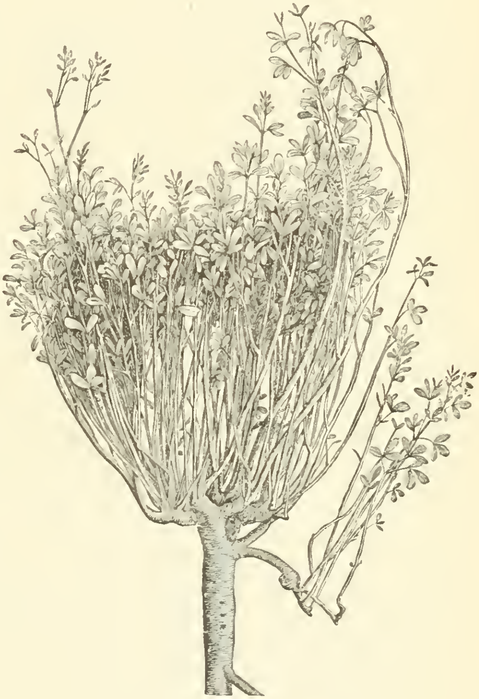

Fig. 2.—Alfalfa (*Medicago sativa*).

MEADOWS.

Bermuda, Johnson grass, and cowpeas furnish fully three-fourths of the hay used in the Gulf States. A dozen or more other species are used to some extent, and a still larger number might be advantageously cultivated. Much of what has been said in regard to permanent pastures applies equally well to the formation of permanent meadows. The more important of the grasses and forage plants used in the formation of such meadows are described below.

ALFALFA.

Alfalfa (fig. 2) is rapidly growing in favor, especially on well-drained alluvial soils, where it gives repeated cuttings and improves with age. On the rich soils along the Red and Mississippi rivers it is especially valuable, and it is also succeeding well in many places along the Gulf coast from Louisiana to Florida. It is not often successful on the yellow or red clay uplands, but is very promising on the strong lime soils, even where the rotten limestone rock comes within a few inches of the surface.

Alfalfa is often grown on lands which are seeded to Johnson grass, and in such fields the yield of hay is very large, from 3 to 5 tons per acre of very fine quality. Such fields make very satisfactory and profitable meadows for a few years; but as the Johnson grass needs an occasional plowing, which can not be given without killing the alfalfa, the latter must be resown each time the land is plowed.

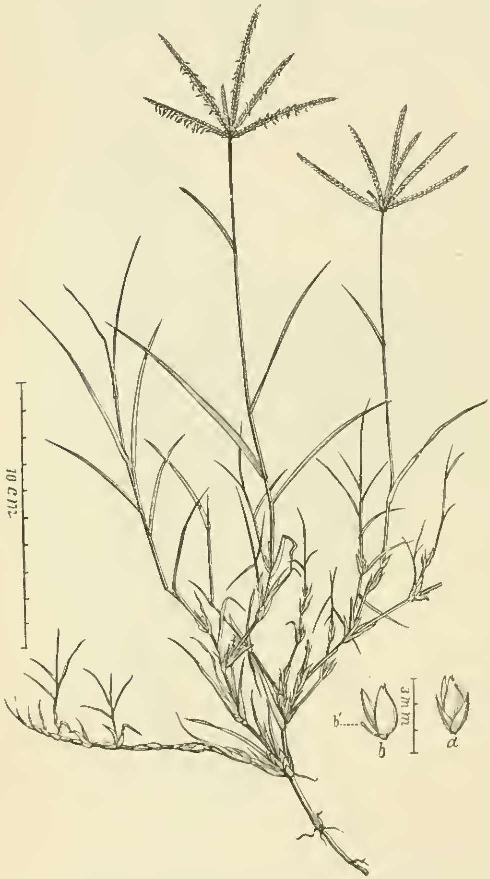

Fig. 3.—Bermuda grass (*Cynodon dactylon*).

BERMUDA GRASS.

In the region in question no grass is used more largely for hay than Bermuda (fig. 3). After a meadow has been in this grass some years the sod becomes so matted with roots that the growth is lessened, and it should be plowed or cut with a disk harrow, in order to give the grass a fresh start. If plowed in the fall, after the last cutting has been made, the field should be sown with oats, vetches, or a mixture of the two. As the sod is very tough, it should be thoroughly harrowed both before and after the seed is sown, and, if possible, finished with a roller, so as to leave the surface smooth for the mowing machine. The oat and vetch crop will make a heavy yield of very superior hay in May, and by October the Bermuda will fully occupy the ground and yield a heavy cutting. As the grass rarely matures seed in this country, the manure made from feeding it may be used without danger of spreading the grass where it is not wanted. Red clover is often sown where the land is first set with Bermuda, and although it does not usually make a heavy growth and becomes very scattering after the first two or three years, it very materially increases the yield of hay, which is superior in quality to either Bermuda or clover.

COWPEAS.

Of all annual plants used for hay, cowpeas are the most important, the most widely used, and the best. The cowpea is one of the few crops which will make rich fall grazing or yield abundant crops of good hay, and at the same time leave the soil in an improved chemical and mechanical condition for succeeding crops. Cowpeas make the best "catch crop" which can be grown for hay. They are the best crop which can be grown on land from which wheat, oats, or any early maturing crop has been gathered. There are many cultivated varieties of cowpeas, some maturing within sixty days from planting, while others continue to grow six months or more. If a heavy yield of hay is wanted the Clay, Whip-poor-will, and Unknown are the best varieties. If the crop is to be pastured the Black, Red Ripper, and Unknown are good; while for stock Black Crowder, Clay, and Unknown give heavy yields. When the crop is to be saved for hay it should be cut as soon as the first pods become yellow, and the planting should be timed so that this will occur during the dry weather of September and October. Although the hay is regarded as being somewhat difficult to cure, it is not so when cut at the proper stage of maturity and handled with care. Bulletin No. 40 of the Mississippi Experiment Station gives the following directions for saving the hay:

> The mower is started in the morning as soon as the dew is off, and run until noon, or until as much has been cut as can be handled in the afternoon. As soon as the top of the cut vines is well wilted the field is run over with a tedder to turn the vines over and expose them more thoroughly to the air and sun. When the crop is very heavy the tedder is used a second time, though this is seldom necessary. Vines which have been cut in the morning and teddered in the afternoon are usually dry enough to put into small cocks the next afternoon, and if the weather promises to be favorable they are left in the cocks two or three days before being hauled to the barn.
>
> If it should rain before the vines are put in cocks they are not touched until the surface is well dried off, and then they should be teddered as though freshly cut. The vines in cocks are not opened until well dried on the outside, and are then handled as little as is possible to secure a thorough airing. A light rain does very little damage to the hay, even after the curing has begun, if handled promptly and properly, and a heavy rain for a day or two may fall on freshly cut vines and do little or no damage. The essential point in making the hay is to do the work as rapidly as possible, and to avoid any handling of the vines when wet with either dew or rain. We find that it pays well to use a tedder for stirring up the freshly cut vines so as to admit the sun and air freely, though if a tedder can not be had the work can be done nearly as well, though more slowly, with a fork.

Cowpeas may be planted at any time from May until August, either broadcast or in drills. If the large growing varieties are planted in hills early in the season, 4 quarts will plant an acre, while if dwarf varieties are sown broadcast in August, 2 bushels should be used.

CRAB-GRASS.

Crab-grass is one of the volunteer grasses used largely for hay. It is a universal growth in fields from which oats, wheat, and other early crops have been harvested, and on rich soils will make a heavy yield of excellent hay. In the northern section it often occupies the ground alone, but in the coast region it is usually mixed with beggar-weed or Mexican clover, especially the latter. On well fertilized, sandy soils near the coast, crab grass, and clover often yield fully 2 tons per acre of hay. It needs unusual care in drying, but if cut before it is overripe, and properly cured, the hay is of good quality.

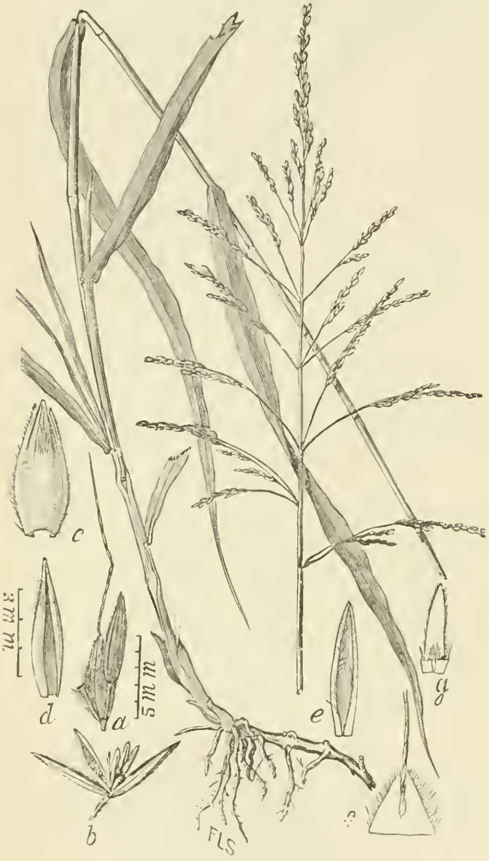

Fig. 4.—Johnson grass (*Andropogon halepense*).

GERMAN MILLET.

German millet in nearly all of its various forms can be grown as a "catch crop" on ground which becomes vacant in June or July, as it will mature in from six to eight weeks from sowing and can be gathered in time for fall planting. The crop is exhausting to the soil, and should be sown only on good ground. Good crops can be made by alternating with hairy vetch, the latter seeming to provide the nitrogen needed by the millet. The vetch is mowed as soon as the seed begins to mature, about the first of June. The land is then plowed and sown with millet, which is cut in July. After that a moderate crop of crab grass can be cut in October, and the vetch seed left in the soil will cover the ground for winter grazing or for an early crop of hay. This is one of the best hay rotations which can be used for a rich and fairly heavy soil.

JOHNSON GRASS.

Johnson grass (fig. 4) is a rich land grass. It is at the same time the most highly praised and the most severely condemned grass found in the South, and both opinions have ample foundation. It undoubtedly yields more and better hay than any other plant grown in this region. It will give from two to four cuttings yearly, and each cutting will make from 1 to 2 tons of hay. The hay, although coarse in appearance, is sweet, tender, and nutritious. Horses and mules prefer it to any other. It is easy to secure a good stand of the grass, and when once established, a meadow is easily maintained as long as the planter may desire. The serious objections to its cultivation are the great difficulty of destroying it when the land is wanted for other purposes and the ease with which it spreads to fields where it is not wanted. In many localities it is the worst weed with which the cotton planter has to contend. It is more persistent on rich, heavy, and somewhat moist soils, and on such soils it is very seldom that it is ever completely eradicated. On dry and sandy soils it can be killed in one season by frequent and repeated plowings, but on heavy soils the fleshy roots will retain their vitality for months, even though frequently disturbed. Practically, it is never completely destroyed when once established on a favorable soil, and the farmer who plants it should do so only after careful consideration and with the expectation that it will remain on the land forever.

When cultivated for hay, the roots form such a dense mat in three or four years that the yield is much lessened. The ground should then be plowed and thoroughly harrowed during the winter or early spring, after which the grass will make a growth as vigorous as ever. The yield of hay is largely increased by sowing sweet clover with it, as the latter makes its first growth so early in the spring as to afford an additional cutting, while its deep biennial roots serve to keep the soil in a much better chemical and mechanical condition. Johnson grass does not bear grazing well, and when pastured it will soon almost wholly disappear, though it will still make sufficient growth to keep the roots alive and ready to start vigorously when the land is plowed again. When Johnson grass meadows begin to fail, many planters pasture them a year or two, and then plant in corn or cotton. Two or three cultivated crops can be grown on such land with very little trouble from the grass, but after a few crops have been made it will usually have regained such a hold that the ground needs only to be smoothed again to make it a profitable meadow. This grass seems specially adapted to the black prairie region and is now more or less abundant in all of that section. In other parts of the country it is more abundant on heavy alluvial soils than elsewhere, and is quite rare along the coast.

RED CLOVER.

Red clover grows well on rich lime soils which are in good condition, but needs to be managed somewhat differently from the method followed in the Northern States. Here, it should be sown in the fall, as soon as possible after the first of September. When sown at that time on well-prepared and finely pulverized soil, the land being rolled to compact the surface soil and prevent it from drying too deeply, the seed seldom fails to germinate and to make sufficient growth to become well established before cold weather. The crab-grass and weeds which come up with it are killed by the first heavy frost, and when the warm days of spring come, the clover grows so rapidly as to keep down the weeds. On good soil it will make from 2 to 2½ tons of hay in May, with another lighter crop of hay or a good crop of seed in July. In favorable seasons it will make a third cutting, after which it usually begins to fail, and the ground should then be plowed for late corn. It is undoubtedly the best of the clover family for rich soils which are in good condition, but it is useless to sow it on barren fields or on rough and poorly prepared lands of any kind. It has not been satisfactory on either sandy or white lime lands.

SOILING AND FODDER CROPS.

The soiling crops available are not numerous, although there are many grasses and legumes which might be used. Alfalfa is used more than any other one plant, and on favorable soils its yield is heavy and continues for a long time. In central Mississippi, Alabama, and Georgia it can be cut once in six weeks from March until its growth is stopped by fall drouth, while further south its growth is more nearly continuous. Teosinte will outyield any other plant on the rich alluvial soils near the coast, but it is not ready for use before midsummer. Johnson grass is used extensively, while millo maize, Kafir corn, Jerusalem corn, and other sorghums yield repeated cuttings from August until killed by frost. In Florida, rice and Para grass are used largely for soiling. A considerable amount of forage, most of which is used on the farm, is made from oats, rice, corn fodder, and other annual crops. Corn fodder, made by stripping the leaves from the stalks as soon as the grain becomes hardened, is used very largely, and considerable amounts of it are sold in the country towns. The forage made in this way, when well cured, is of excellent quality, but so much work is necessary in gathering it that it can not be made profitably with hired labor. A large part of what is saved is gathered by laborers on shares, the share of the planter thus costing him nothing except the injury to the grain crop, which may amount to as much as 18 per cent of the grain when the fodder is stripped before the leaves have ceased their growth.[1]

When oats are cut just after heading, they make hay of the finest quality, though if allowed to stand a few days too long but little of the straw will be eaten. As the crop is one which can be grown during the winter on ground from which corn or some other crop has been harvested, and is off the ground in time for planting in the spring, it is often the cheapest hay crop which can be grown.

Rice is grown for hay near the coast, and has about the same hay value as oats in the northern sections. Two successive hay crops are often grown on the same ground during the year, the yield of each crop being about the same as that of oats, averaging about one and a half tons per acre of each.

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[1] Bulletin No. 30, Mississippi Agricultural Experiment Station.

As nearly the whole country is covered with timber very little wild hay is cut excepting in the prairie region of Louisiana. There several species of water-grasses are the common species of the wild lands, and make a very fair hay.

THE MORE IMPORTANT HAY AND PASTURE PLANTS.

In the following list only the more important of the native or cultivated hay and pasture plants are named. Many of these are rarely seen in other sections of the country; a few are regarded as worthless weeds in other localities; while others, common and valuable elsewhere, have not proved suited to the soil and climate of the Gulf States.

GRASSES.

Bermuda Grass (*Cynodon dactylon*) (fig. 3).—An extensively creeping and spreading perennial, stems slender; leaves numerous, spikes digitate, much like those of crab-grass, but shorter and more slender. Bermuda grass is to the South what Kentucky blue grass is to the North, and is the best hay and pasture grass for all soils which are not too wet. It is the most common grass in all parts of the Gulf States, and the vigor of its growth is a very good indication of the quality of the soil on which it is found. Its leaves and stems are so fine, and its creeping stems lie so close to the ground, that it makes an excellent lawn grass. Bermuda grass is never injured by protracted drought, and is unhurt by the most frequent grazings or cuttings. Its rootstocks are so strong and wiry that it is the best of soil-binders, and is used extensively for protecting levees and embankments. It is one of the best grasses for grazing, and may well be used in the Gulf States as the foundation for all permanent pastures. As a hay grass it is unexcelled. In favorable seasons it will give two cuttings, and on good soils its yield is from 2 to 4 tons of hay per acre.

Bermuda grass is usually propagated by transplanting the roots. This may be done at almost any time except during the coldest winter months, and the work is not more expensive than is the seeding of ground in the ordinary manner. Shave off sods an inch or two in thickness, cut them in pieces about an inch square. and drop on the ground about two feet apart each way, stepping on each one and crowding it into the soft ground as it is dropped. If it is necessary to do the work when the ground is too hard for this method, one man can make small holes with one stroke of the hoe, while another drops the sods and covers them with his foot. When the ground is in good condition, and the sods convenient, one man can plant an acre in a day.

If seed is used in propagating Bermuda grass the ground must be very carefully prepared, being harrowed as fine as possible. The seed should be sown in March, at the rate of about 6 pounds per acre and covered with a roller, though if sown just before a rain no other covering will be needed. As the seeds are small they must not be covered deeply or they fail to germinate. Being expensive and unreliable, seed is seldom used.

If the land is to be used for pasture only, the easiest means of securing a sod is to run shallow furrows from 2 to 4 feet apart into which sods are dropped every few feet and tramped into the soft soil. This method does very well for pastures, but leaves the ground too rough for mowing. So easily may Bermuda grass be propagated that good stands can be secured by scattering a dozen or more sods to the acre and then cultivating the land in corn or cotton two or three years, after which the grass will have become so well distributed that the field will need only to be plowed and harrowed once in three to five years. The yield is greatly increased, and the grass responds very quickly to an application of fertilizer, especially of stable manure.

When once established, it is somewhat difficult to eradicate, and this is occasionally an objection to its general cultivation. The best method of destroying it is to plow the ground immediately after the hay is cut, leaving it as rough as possible. Plow again in November and sow to oats, and when that crop is harvested plow again and sow thickly with cowpeas, which will smother the few plants which may have survived the oats and will leave the land in fine condition for any future crop. Ton for ton, Bermuda grass has a feeding value fully equal to that of the best timothy, and many horsemen prefer it to any other hay.

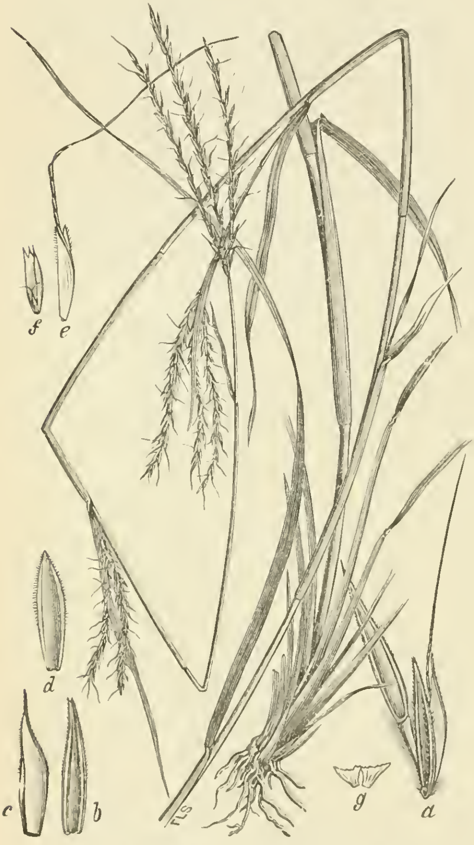

FIG. 5.—Big Blue-stem (*Andropogon provincialis*).

Broom-sedges.—The Broom-sedges are among the characteristic grasses of the Gulf States, no less than forty species and varieties being found there. All have the same general character, yielding a great amount of grazing and hay of fair quality if cut early, but becoming dry, hard, and woody with the development of the flowering stems, and almost worthless in the late autumn. Some species are among the most common of the large grasses in the dry pine barrens, while others grow only in the damp savannahs, or act as sand binders on the island sand dunes. Under continued pasturing they give way to other grasses, and only two or three make their appearance again in fields which have been once cultivated. All are perennials, but are killed by the first plowing.

BIG BLUE-STEM (*Andropogon provincialis*) (fig. 5.).—Usually in clumps, from large, coarse rootstocks; stems 3 to 6 feet in height, with several branches, more or less purple in color; leaves long and abundant, smooth or hairy; spikes 2 to 4, digitate at the summit of the branches; spikelets sparsely covered with rusty or yellowish hairs.

This is the most valuable species in the group and is used more largely for hay than any other. If cut when the flowering stems are not more than half grown it makes excellent hay, but, unfortunately, it reaches that stage at a time when most planters are crowded with work in the cotton fields, and hence is usually cut too late to make forage of the best quality. It has a large cluster of tender root-leaves which cure on the plant and remain there during the winter, forming an important addition to the winter forage. While there are other grasses which are better worth cultivating, the spontaneous growth of this is valuable.

BROOK-GRASS (*Andropogon glomeratus*).—Most abundant on marshes and low ground; stems large and coarse, 2 to 6 feet high, branching much toward the summit; leaves very long, rather wide, smooth, and glaucous, or hairy; spikes usually densely crowded at the summit of the stem.

This is quite common and abundant on damp soils, and its long and abundant leaves give it considerable value for grazing, but its stems are too coarse and woody for hay.

BROOM-SEDGE (*Andropogon virginicus*).—Stems strictly erect from an almost woody base, flattened below and loosely branched above; lower leaves about 1 foot long, upper leaves shorter, smooth or hairy; panicle long and loose; spikes usually in pairs and partially inclosed by the sheaths; spikelets covered with white or yellowish hairs, and with awns nearly four times their length.

One of the most common species in old fields and on dry soils, being usually the first to make its appearance in old fields and often causing great annoyance in meadows. When young and tender it is grazed to some extent, but soon becomes tough and worthless. It is one of the most troublesome weeds of lawns and meadows, and has so little value for pastures that its growth should never be encouraged.

BUNCH-GRASS (*Andropogon tener*).—Stems very slender, with many widely spreading branches; leaves numerous, narrow, short, and smooth; spikes single, 1½ to 3 inches long, slender; spikelets slightly hairy, half as long as the bent and twisted awn. The most slender and earliest flowering species in the group.

Very common in open, dry pine barrens, but the numerous stems are so wiry and the leaves so slender that it is not eaten well when other grasses are available.

JOHNSON GRASS (*Andropogon halepense*) (fig. 4).—Perennial from long, creeping rootstocks; stems single or in clumps, erect-branching, coarse, 3 to 6 feet; leaves numerous, long and broad, panicle open and spreading; seeds large and numerous. Much like a small sorghum in general appearance.

This grass has been in cultivation in this country since about 1830, and is now quite generally distributed through the Gulf States. It grows best on the rich and heavy lime soils of the black prairie region and along the creek bottoms of the yellow-loam region, and is rarely seen in the pine-woods region near the coast. In localities where it grows well it is at the same time one of the most valuable hay grasses and the most troublesome and pestiferous weed. As a pasture grass it has but little value, as it begins its growth late in the season and the tops are killed by the first heavy frost in autumn. Its large and fleshy rootstocks are near the surface, and are so injured by trampling that the grass soon almost wholly disappears from the fields, though there is always enough left to restock the land when it is again brought under the plow. Its greatest value is as a hay grass, and for that purpose it can not be excelled. On land which is suited to its growth it will give at least three cuttings annually, and make a total yield of from three to five tons per acre. The hay is coarse and not attractive in appearance, but stock of all kinds eat it greedily, seeming to prefer it to any other hay. Liverymen who have used it state that it is the best hay they can find, but it is rarely fed in stables where there is a ready sale for the manure, for the seeds spread the grass wherever the manure may be used. But if the hay is cut, as it should be, before the heads appear, the manure from it can do no harm.

The objections to the cultivation of Johnson grass are the rapidity with which it spreads to fields where it is not wanted, and the great difficulty in eradicating it from fields where it has become established. It will soon almost disappear when fields are pastured, but the roots remain alive and will again take possession of the field as soon as it is plowed. Instances are known where fifteen and even twenty years of continuous pasturing have failed to produce any appreciable effect on the vitality of the roots. When there are only occasional small patches of it in a field they can be destroyed by hoeing and covering with salt to the depth of half an inch, but when it covers any considerable portion of a field the only practicable method of killing it is by weekly hoeings continued from early spring until late summer. On sandy soils it can be readily killed in this manner, but on heavy clay or black lands the work is more difficult, and will require a longer time. In any case, the field should be watched constantly for plants which are almost sure to make their appearance from seeds washed in from adjoining fields or dropped by birds, cattle, or passing teams. It is so difficult to eradicate that it is rarely advisable to sow it on clean land, but if it is already established on the land it is often better to encourage it than to fight it, as a heavy crop of good hay is more profitable than is an ordinary crop of either corn or cotton.

LITTLE BLUE-STEM (*Andropogon scoparius*) (fig. 6).—Stems usually in clumps from strong roots, 2 to 4 feet high, flattened at the base, with numerous long branches, usually tinged with red or purple; lower leaves long and numerous, upper leaves short, smooth, or hairy; spikes on long and slender peduncles, single, 1 to 2 inches long, with 5 to 10 joints.

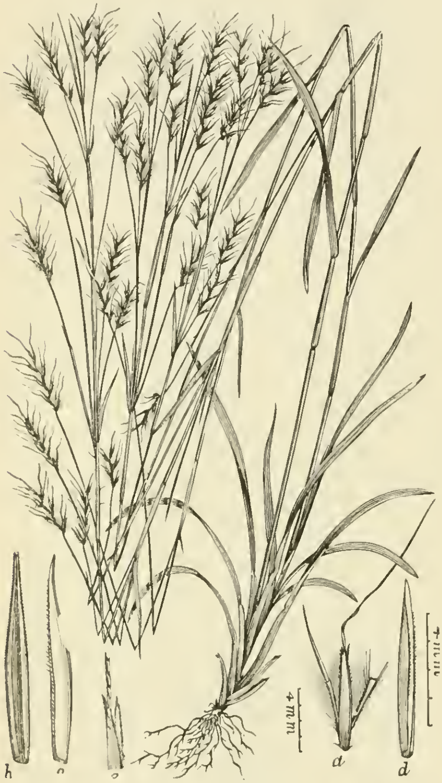

FIG. 6.—Little Blue-stem (*Andropogon scoparius*).

Very common in dry fields and easily recognized by its purplish color and its habit of growing in bunches. Next to the Big Blue-stem this is the most abundant and valuable of the group, and furnishes a large part of the natural pasturage. It has a less abundant supply of leaves than the former, and the stems become hard and woody sooner, so that it is less valuable for hay.

SEASIDE BROOM-SEDGE (*Andropogon maritimus*).—Stems slender, coming from a crown which is often a foot or more below the surface of the sand, 1 to 2 feet tall, not branched; leaves 3 to 6 inches long, very numerous, and abruptly reflexed, sheaths overlapping; spikes single, or sometimes in pairs, 1 to 1½ inches long, partly inclosed by the sheath of the subtending leaf.

Found only on the sandy coast lands and islands, where it is a valuable species. As its roots are buried deep in the sand, it acts as an excellent sand binder, suffers but little from dry weather, and can not be pulled up by cattle. Stock appear to be very fond of it, as it is usually eaten down closely before other broom-sedges or other grasses are touched.

Bur Grasses (*Cenchrus*).—Annuals, with spreading or decumbent and much-branched stems, 1 to 3 feet high; spikes single, with from 5 to 25 spiny burs.

There are several species of these grasses which are common on the sandy lands of the South, especially near the coast. While young the leaves are tender and are grazed closely, but after the seeds with their spine-like coverings are developed they are avoided. Sand bur (*C. tribuloides*) is the most common and a troublesome weedy species, while the cockspur (*C. echinatus*) is the largest and is often cut for hay.

Crowfoot Grass (*Dactyloctenium ægyptium*).—Annual; stems several and branching, erect or spreading, 1 to 2 feet high; leaves numerous, long, smooth; spikes 2 to 5, 1 to 2 inches long, digitate.

A common grass in cultivated grounds from central Alabama and Georgia southward, coming up as a volunteer crop after oats, melons, and other early field crops have been harvested. It is usually more or less mixed with crab-grass, Mexican clover, and beggar-weed, and is highly valued as a hay plant. It comes up so late in the season that it is rarely troublesome as a weed. Most feeders prefer it to crab-grass, as it cures more easily. It appears to be more abundant in Georgia than elsewhere, and in many sections of that State nearly all the hay saved for home use is from this grass, grown in cornfields. Crowfoot hay is of good quality, though the yield is seldom more than one ton per acre when the grass is grown alone; it is often double that amount when mixed with Mexican clover or beggar-weed.

Feather-grass (*Leptochloa mucronata*).—Annual; stems clustered, erect, branched from near the base, 2 to 3 feet; leaves rather numerous, long, flat, somewhat roughened; panicles large and widely spreading, branches very slender and wiry; spikelet small. Common in rich, cultivated ground, and quite showy, but the leaves are so rough and the stems so hard and woody that stock refuse it when grazing, and it has almost no value. Usually regarded as a weed.

Goose-grass (*Eleusine indica*).—Annual; at first prostrate, but finally becoming erect; stems much flattened, smooth, 1 to 2 feet high; leaves numerous, long, smooth; spikes 3 to 6, digitate, 1 to 2 or 3 inches long.

A late species, which grows in cultivated ground in all parts of the South and is everywhere regarded as a troublesome weed. When sufficiently abundant to be cut for hay it makes a good crop, and as it makes its best growth late in the season it adds considerably to the fall grazing.

Japanese Wheat-grass (*Brachypodium japonicum*).—A short-lived perennial; stems several, spreading or upright, 2 to 3 feet tall; leaves numerous, long, nearly smooth, one-half to three-fourths of an inch wide at the base; spikes 6 to 10 inches long, rather diffuse; spikelets half an inch in length, with awns twice as long; whole plant usually more or less tinged with purple.

A winter-growing plant, first introduced into California from New Zealand, which does well under the same treatment as that required for Rescue grass, being at its best in March and April. It is valuable as a part of a mixture for newly prepared pasture lands. It has succeeded well in trial plots at all the Southern experiment stations, but has been less successful under ordinary field conditions.

Kentucky Blue grass (*Poa pratensis*).—This grass is not the uniform success in the Gulf States which it is farther north, though in some places it is of considerable value. On low ground where the soil is dark colored and contains an abundance of lime and on seepy hillsides it sometimes gives good late fall and winter grazing, but it is useless to sow it on dry clay hills, and it nowhere makes the smooth lawns and broad meadows which it does in more northern States.

Lizard-tail Grass (*Hackelochloa granularis*).—Annual; stems usually single, erect, much branched, 2 to 4 feet; leaves few at the base, very abundant on the stems, rather long and wide, rough; spikelets terminating the branches, 1 to 2 inches long, slender; seeds abundant.

An introduced species which is found occasionally in cultivated places, though rarely abundant. As it produces an unusual amount of seed, it makes a very rich hay, though the lower part of the stem is rather hard and dry. Regarded as valuable where it grows spontaneously, but not deemed worth cultivating.

Millet (*Chætochloa italica*).—When a crop of hay is wanted from land which has been occupied by some early crop, some variety of millet can often be used to advantage. It is a grass which requires rich land, and is exhausting to the soil; hence should not be followed by cotton or corn, though it may often be used to precede clover or the seeding of a field for permanent pasture. If cut early, before the seeds begin to harden, it makes excellent hay, but if the stems are allowed to mature they become so hard and woody that they are not eaten, and the seeds, if fed in any considerable quantity, are often injurious to horses and mules. The crop sometimes fails on account of a drought soon after sowing, but if rains follow, so as to germinate the seed and give the plants a fair start, they suffer little from later droughts. There are several varieties, differing principally in size, the form known as German millet being the largest, growing from 3 to 5 feet high, and making the best yield on heavy soils; the common millet, growing from 2½ to 4 feet high, being the best variety for light soils; and Hungarian millet being the smallest and most quickly maturing sort of the three. Seed may be sown at almost any time during the summer, even as late as the first of August, at the rate of from 35 to 50 pounds per acre, and the early maturing sorts will be ready for cutting in about forty days from sowing.

Nimble Will (*Muhlenbergia diffusa*).—Perennial; stems numerous, much branched, spreading and ascending, very slender and wiry, 1 to 2 feet; leaves numerous, short, narrow, slightly roughened; panicle very slender, 3 to 6 inches; branches few, erect; rather densely flowered.

Very common in dry, shaded places, especially along fence rows, on the borders of woods, and about dwellings. The stems are so tough and wiry that the grass is difficult to mow, but it often forms a considerable addition to the winter grazing. A very good pasture grass, but hardly worth cultivating.

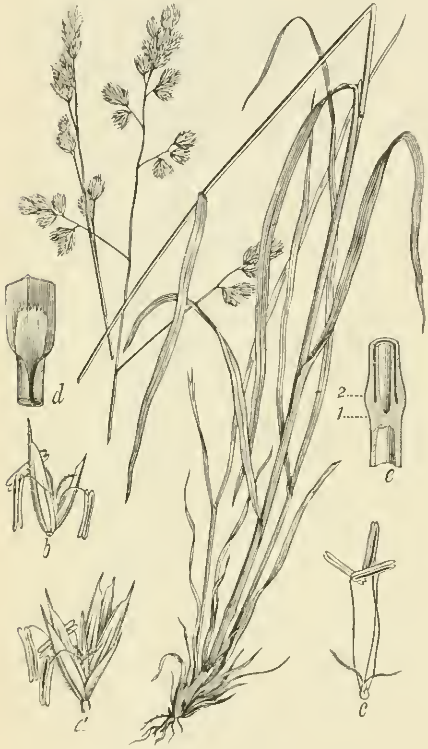

FIG. 7.—Orchard grass (*Dactylis glomerata*).

Orchard Grass (*Dactylis glomerata*) (fig. 7).—Perennial; stems in large clumps, erect, simple, 2 to 3 feet high; leaves very numerous, flat and broad, slightly roughened, often 18 inches in length.

This is one of the most widely grown of the cultivated grasses, and in the Gulf States is one of the best for winter pastures, as it makes a good growth on wet and heavy clay soils with ordinary field treatment. It commences its growth with the first warm days of February, and if not pastured is ready to cut for hay in April, and will then afford excellent grazing until checked by the summer drought. With the first autumn rains it starts a new growth of leaves, making rich fall pasturage, and remaining fresh and green throughout the winter. The hay made from it is of excellent quality, though its habit of growing in large clumps is against its use as a hay grass; but it bears grazing well and recovers quickly when cropped down. It does well when mixed with redtop, or alsike clover, and succeeds better than almost any other grass in woodland pastures. Sandy soils are not suited to its growth, and it can not be recommended for light and thin lands. Seed should be sown in August, or very early in the spring, at the rate of 30 to 40 pounds per acre.

Panic Grasses.—The genus *Panicum* contains more species than any other in the Gulf States, no less than 91, besides numerous varieties, having been found there, many of them being peculiar to that region. They grow in all situations, from swamps to dry hilltops. Some of the species are found only on wild lands, where they furnish more than half the grazing, while others rarely occur except on lands which have been in cultivation, and where they often make heavy yields of hay, which costs nothing but the harvesting. Although so abundant, there are few species which are really worth cultivating. They are the natural grasses of the wild lands, and few of them flourish under the changed conditions brought about by cultivation. The following are among the more important species.

AUTUMN PANIC (*Panicum autumnale*).—Perennial; stems numerous, often in clumps of considerable size, spreading, 6 to 12 inches; leaves very numerous, short; panicle large and diffuse, about as long as the stem; branches very slender.

It grows on thin and dry upland soil, where it often forms a large part of the late summer and fall grazing. The var. *pubiflorum* is the more common form in central Alabama and Georgia, and stock graze it freely, but it is not worth cultivating.

BARNYARD GRASS (*Panicum crus-galli*).—Annual; stems single or in clumps, erect, sparingly branched, 3 to 6 feet high; leaves very long and abundant; panicles heavy and compact; spikelets awned or awnless.

This requires a rich and somewhat moist soil, its name, "barnyard" grass, indicating the locality which it prefers. It is a coarse and succulent grass, which is not easily cured into hay, but it is quite valuable for soiling and for the silo, as it yields heavily and produces an unusual amount of seed. In some sections of Mississippi and Florida it makes a good part of the volunteer growth which is used for hay. Dr. Phares, of Mississippi, says that "hundreds of acres are annually mowed, and farmers who have tested it thoroughly for many years prefer it to the best corn fodder." Several varieties of this, under the name of "Japanese barnyard millet," have been recently introduced and promise to be of great value. No reports of the value of these millets have been published from the Gulf States, but they have made such good yields in the north that they should be carefully tested there.

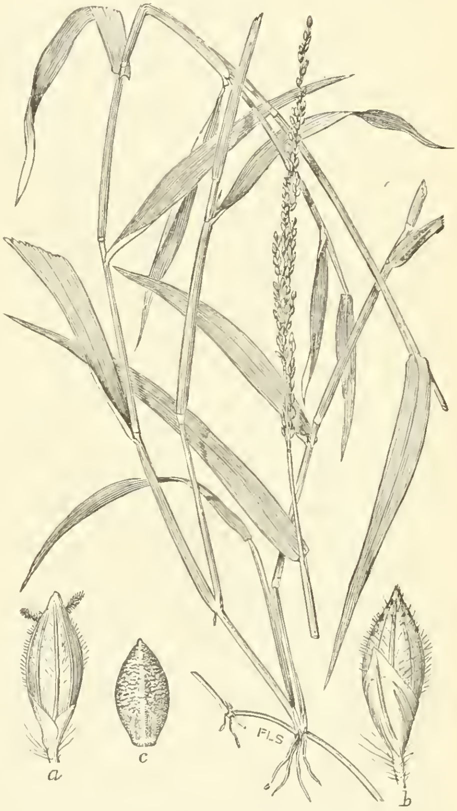

FIG. 8.—Colorado grass, or Texas millet (*Panicum texanum*).

BITTER PANIC (*Panicum amarum*).—Perennial, from long, creeping, and branching rootstocks; stems erect or decumbent, not branched, 2 to 5 feet tall; leaves long and numerous; panicle erect, slender, often partly inclosed by the sheath of the upper leaf; whole plant very smooth and blue-glaucous.

This grass is confined to sandy beaches, and is one of the more prominent sorts on the coastal islands, where it furnishes grazing for hundreds of cattle. Its long and tough rootstocks and its ability to grow in the sandiest soils make it a valuable sand-binder.

COLORADO GRASS, or TEXAS MILLET (*Panicum texanum*) (fig. 8).—Annual; stems few, branching or erect, often rooting at the base, 2 to 4 feet; leaves very numerous, large, nearly smooth; panicle 4 to 8 inches long, slender, branches closely flowered.

This has very much the same habit of growth as crab-grass, but is larger and coarser. It prefers low, damp soils, and in suitable locations will make two or three cuttings in a season, the hay being of very good quality. Like crab-grass, it reseeds the ground freely, and will often make a heavy volunteer crop after cultivated crops have been harvested, though it never becomes a troublesome weed. It is grown quite largely in some parts of Louisiana, and is regarded there as being the best of the annual grasses for a volunteer hay crop.

CRAB-GRASS (*Panicum sanguinale*).—Annual; though often perennial by its spreading stems, which root at each joint near the base; stems many and branching, spreading 2 to 4 feet long; leaves very numerous; 3 to 5 spikes, 3 to 5 inches long, digitate.

The most common grass in cultivated ground, making its principal growth late in summer after other crops have been harvested or laid by, and so furnishing a large amount of hay with no expense, excepting that of harvesting. Although not often on the market, crab-grass furnishes more forage for home use in the Gulf States than any other grass. When oats, melons, and other early crops have been harvested it will soon cover the ground, and by October will often make a yield of 2 tons per acre, while in the pine woods and coast region it will make nearly or quite as much on land from which corn has been harvested in August. Near the coast it is usually more or less mixed with Mexican clover, and on soils which are well fertilized the mixture will often give as much as 3 tons per acre of excellent hay. The objection to the hay is that, if allowed to become overripe before cutting, the seed shatters off badly and the stems become woody and tough. It is also rather difficult to cure, and must be allowed to dry several weeks before it can be baled with safety.

GUINEA GRASS (*Panicum maximum*).—Perennial by stout, creeping rootstocks; stems numerous, often in large clumps, coarse, 10 to 12 feet; leaves very numerous, large; panicle loose and spreading.

Probably an African species, but now well established in many sections of Florida and grown occasionally at other places near the Gulf coast, where it is valued highly for both hay and pasture. In regions suited to it, it grows very rapidly, and needs to be cut about once a month to prevent the stems from becoming too large and coarse. It makes good grazing and gives a constant and heavy yield for soiling. Seed ripens only in the extreme South and it is usually propagated by means of pieces of the rootstocks, which grow readily when transplanted. The stems are killed to the ground by the first heavy frost, and if the ground freezes slightly the roots are killed also. It has sometimes been confounded with Johnson grass, but is much less hardy and is much coarser and less valuable as a hay plant. Also, it is less troublesome as a weed.

MAIDEN CANE (*Panicum digitarioides*).—Perennial, from widely spreading rootstocks; stems erect, simple, smooth, 3 to 5 feet; leaves very abundant, broad, tender; panicle long, its branches long and slender.

Common in ditches and along the borders of marshes, where it affords a large amount of good grazing. It will not endure drought and is of little value for hay. Its strong creeping rootstocks make it desirable as a soil binder.

MUNRO GRASS (*Panicum agrostoides*).—Perennial; stems clustered, branched, erect, smooth, 1 to 2 feet; leaves very numerous, often a foot or more in length; panicles pyramidal, terminating each of the branches, much like those of redtop.

This is a wet-ground species which is very common on the borders of ponds or marshes and along the banks of streams, where it frequently makes a dense growth covering considerable areas. It makes good though rather coarse hay, of which two cuttings can be made in a season, but as it grows best on land too wet and uneven for mowing, its chief value is as a pasture grass. For late fall grazing it is one of the best of the family, and is well worth sowing on the wet places in pastures, but is worthless for dry soils.

MUTTON-CANE (*Panicum dichotomum*).—Perennial; stems clustered, spreading, much branched, very slender, 10 to 15 inches; leaves numerous, short, and narrow;

panicles loose and spreading, rather large, and on long peduncles in the spring, but small and almost sessile later in the season.

One of the most abundant native species, usually occurring on lands which have not been in cultivation. It is exceedingly variable in its habit of growth, assuming very different forms at different seasons, but making an almost continuous growth and forming the best part of the pastures on the pine-woods soils. During the winter its growth is confined to a tuft of very broad leaves at the surface of the ground, but in early spring stems are formed which continue to branch and produce seed until late in the fall. Sheep are especially fond of this grass, and many flocks live upon it almost wholly during the winter. Although so valuable in the native pastures, it is soon crowded out by other species when the land is pastured too closely or is brought into cultivation.

PARA GRASS (*Panicum molle*).– Perennial; stems decumbent and often 10 to 20 feet in length, with a few feet at the extreme end becoming erect; leaves very abundant, long and broad; panicle loose and spreading, 9 to 12 inches long.

This has been introduced from the West Indies or South America, and, where the climate is not too cold in winter, will produce an immense amount of forage. It does not mature seed in this country, but the roots live through the winter, the new growth being ready to cut by June 1, and it will furnish good cuttings every six weeks from that time until the end of the season, although it should not be cut after October 1, in order that it may have time to produce a crop of leaves to serve as a winter protection to the roots. It is of considerable value near the coast, but is too tender for regions subject to severe frosts.

SMOOTH CRAB-GRASS (*Panicum lineare*).—Perennial by creeping stems; stems prostrate, rooting at the joints; leaves very numerous, short, hairy, light colored; spikes digitate like those of crab-grass, but shorter and more slender.

Common on cultivated ground, especially on sandy soils, where it frequently forms a thick mat similar to carpet-grass. It remains green and continues to grow during the winter, and is grazed to some extent, but can not be regarded as valuable. When cattle are grazed on fields containing a large proportion of this grass they often become "sanded" from the accumulation of sand in the stomach, and losses from this cause are not uncommon.

SPROUTING PANIC (*Panicum proliferum*).—Annual; stems many and diffusely branched, succulent, smooth, 2 to 4 feet long; leaves very numerous, large and smooth; panicles many, diffusely branched.

This grows naturally on rich, moist soil by roadsides and ditches, but is often abundant in cultivated fields with crab-grass. It is rather difficult to cure for hay, but cattle and mules are very fond of its sweet and juicy stems, and as it makes its best growth late in the season after many of the early grasses have been killed by drought it is of considerable value, although hardly worth special cultivation.

Poverty Grasses (*Aristida*).—The species in this group are easily recognized by the 3-parted beard at the upper end of each spikelet. They are widely distributed, growing in every variety of soil, but are not usually regarded as valuable anywhere. They are among the first grasses to take possession of worn-out and abandoned fields, roadsides, and other barren spots, and their presence is usually regarded as an indication of a thin and unproductive soil. A few of the species are common on good soils, and in the dry pine barrens they form no small part of the grazing for spring and early summer, but are never grazed after the culms begin to grow. *A. stricta* is one of the numerous perennial "wire grasses" of the pine woods, growing in clumps 2 to 3 feet tall. This gives more grazing than any other of the group, but is a pest to sheep, as the sharp, bearded "seeds" catch in the wool and often work their way into the skin. *A. palustris* is a common swamp species, growing 3 to 4 feet tall, but is coarse and harsh, even when young. *A. gracilis* is a small and slender species, seldom more than a foot in height, which is occasionally found in cultivated lands and is one of the first to appear when cultivation has ceased. As a whole, the *Aristidas* are more nearly worthless in the South than any other group of grasses, though none of them become troublesome weeds.

Purple-Top (*Anthænantia rufa*).—Perennial, from a stout rootstock; stems usually single, 2 to 3 feet tall; root leaves abundant, long, narrow and smooth, stem leaves few and short; panicle compact, 3 to 5 inches long; spikelets very hairy and usually bright purple.

Common on the pine barrens of the coast region, although nowhere making a dense growth. It is eaten well, even when quite mature, and it is an important element in the natural pasture. There is another species (*A. villosa*) which is found on damp soils. The root leaves are short and few, lying flat on the ground, so that it has little grazing value.

Redtop (*Agrostis alba*).—This grass is found in nearly all parts of the United States and presents many forms by some regarded as distinct species. Its greatest value in the Gulf States is as a pasture plant for damp soils. For this purpose the form having long, underground rootstocks (*Agrostis stolonifera*) is the best, as it is least injured by trampling. It does best on a soil which is rich and moist, but will grow fairly well on a dry clay soil, although not on dry sand. It bears continued overflows without injury, even when covered by water two or three weeks, and on most soils is more persistent and productive than Kentucky blue grass. It is one of the best grasses for winter and early spring grazing, and should be used on the damp places in every pasture. It makes a moderate yield of fair hay and is especially valuable for mixing with orchard grass, alsike clover, and other moisture-loving sorts. It makes but little show the first season after seeding, but becomes stronger and more dense with age, and holds its place well against other grasses and weeds. In seeding, one bushel per acre should be used, and to that it is well to add half a bushel of perennial rye-grass, which will occupy the ground the first year, but will disappear as the redtop becomes stronger.

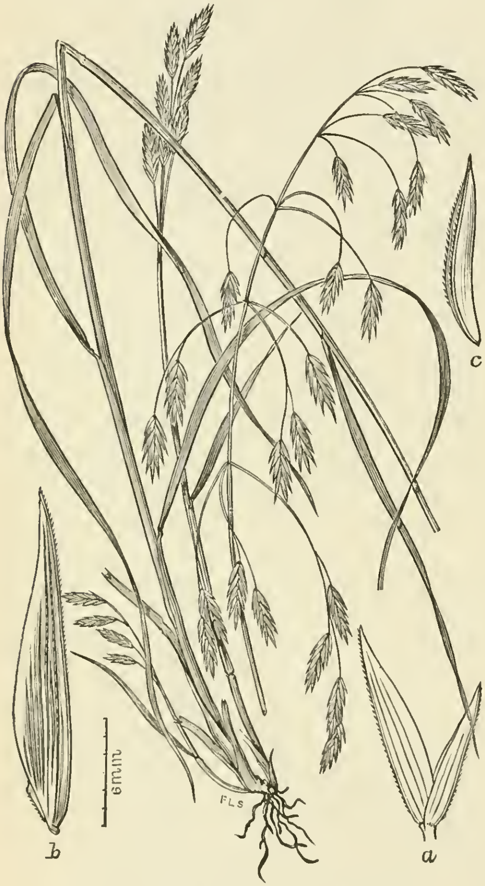

FIG. 9.—Rescue grass (*Bromus unioloides*).

Rescue Grass (*Bromus unioloides*) (fig. 9).—Annual or perennial; stems single or in small tufts, erect, not branched, 2 to 4 feet high; leaves numerous, long, tender; panicle large, loose, and spreading, spikelets drooping.

This is apparently a native of the southwestern part of the United States, and was one of the first of the native grasses to be brought into cultivation. It is known as Australian oats, Australian brome, Arctic grass, and Schrader's brome. Although usually an annual, repeated cuttings or persistent grazing will prevent seed-bearing, and so enable the plant to live several years. It grows best on a rich, loamy soil, and in most localities should be treated as an annual, as it is soon crowded out by other grasses on land which has not recently been plowed. It seeds freely, and yields volunteer crops as far north as the District of Columbia. When sown on suitable soil in August or September it begins its growth with the first autumn rains, and in a favorable season will give good grazing in December, while in a dry and unfavorable season it may be worth but little before February or March. When at its best it will often give two good cuttings for hay. Should it be desired to grow it continuously on the same field, the land ought to be plowed after the seed has matured, and during the summer it may be used to grow a crop of cowpeas or of crab-grass, which should be cut in September to permit the rescue grass to secure an early growth. Seed should be sown in August or September at the rate of from 30 to 40 pounds per acre.

Rough Bent (*Agrostis scabra*).—An annual with slender, smooth, clustered stems and open panicles, 1 to 2 feet long, with widely spreading, capillary branches. Found everywhere, but more common on rather dry and hard clay soil. It makes its growth early in the spring, and so adds some forage to the early pastures, but it is not eaten after it comes into bloom in May, and soon disappears.

Rye-grasses (*Lolium italicum* and *L. perenne*).—Short-lived perennials; stems clustered, often decumbent at the base, becoming erect, 2 to 3 feet tall; leaves very numerous, dark green, rich and tender, 4 to 8 inches long; spikes long and slender, often drooping.

These are among the oldest cultivated grasses, and are probably grown more widely than any others in Europe. They have been used largely in the Northern States, where they are often satisfactory, but in the South they have not done well except in a few especially favorable locations. They succeed best on a rich, moist, sandy soil containing a fair amount of lime, and on such soils are fairly permanent, but on dry, thin soils and heavy clays they soon disappear. They will cover the ground sooner and make a better sward in a few weeks after planting than will most other grasses, and so are valuable where quick results are wanted and for covering the ground while other and more permanent sorts like redtop or orchard grass are becoming established. When sown alone on rich soils their growth is so rank that the ground is soon covered with a dense mat of long leaves, which make the best of grazing or hay, but if allowed to become too dense will die and decay after heavy rains. While excellent for mixing with other grasses for both pastures and meadows, they can not be recommended for sowing alone. The more common varieties are the Italian, Pacey's, and the perennial rye-grasses. The perennial or English rye-grass is the longer lived and so the best for permanent pastures. The Italian rye-grass makes a ranker growth and covers the ground more quickly. Seed may be sown in either fall or spring, and from 2 to 3 bushels per acre are required when sown alone or 1 bushel when sown with other grasses.

Salt-grass (*Distichlis spicata*).—Perennial, from long, creeping rootstocks; stems slender, erect, wiry, branching; leaves short, smooth; spikes of two forms, staminate and pistillate, the first rather slender, while the latter are shorter and thicker.

Growing on salt marshes everywhere, and of little value except as a sand or soil binder. When not too old and tough it is eaten by horses and mules, where other grasses are not to be had, but it makes poor grazing and is worthless for hay.

Side-oats Grama (*Bouteloua curtipendula*) (fig. 10).—Perennial; stems single or few together, simple, erect, 2 to 3 feet tall; leaves 6 to 12 inches long, rough; spikes forming a long raceme and usually reflexed, about half an inch long, purple.

This is the southeastern representative of the large group of grama or mesquite grasses which are so numerous in the pastures of the Southwest. Like them, it grows on dry soil, is rarely injured by drought, and is so deeply rooted that it is not injured by grazing. It is found from Mississippi to Georgia, though rarely abundant, and its growth should be encouraged. The seeds are easily gathered and grow readily on lawns already set with other grasses. There is another *Bouteloua* found in Florida, but neither species is so abundant as to be of much importance.

Small Cane (*Arundinaria tecta*).—Perennial; stems woody, branching above, from a few inches to many feet in height; leaves numerous, lanceolate, somewhat rough and hairy, remaining green until the second season. Seeds as large as grains of barley, in panicles resembling those of rescue grass; maturing in February and March. There is also a second species, *A. macrosperma,* which sometimes reaches a height of 40 feet. These canes are indigenous on alluvial lands and along streams throughout the whole Gulf region, reaching their greatest perfection on the low lands near the Mississippi River and in Florida, where they often form extensive "canebrakes" whose growth is so dense as to be almost impenetrable. It is too woody to be cut for hay, but where it grows in sufficient abundance it makes valuable winter grazing, and thousands of cattle are wintered without any other feed. The seeds are produced on slender canes from 1 to 3 feet tall, but only at long intervals, and the whole plant dies soon after the seed is matured. Usually all the plants in a locality, which may be from a few rods to many acres in extent, produce seed the same season. Cattle fatten rapidly on the large, starchy seeds, and the dying plants are replaced by a new growth the following season. Attempts to cultivate the cane, either by seeding or by transplanting roots, have not been very successful, and as it grows only on the richest soil its area is rapidly decreasing with the opening of new fields.

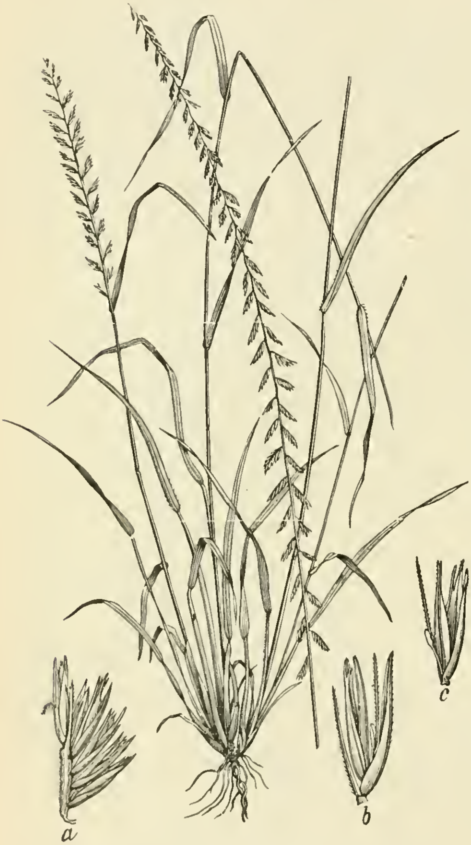

Fig. 10.—Side-oats Grama (*Bouteloua curtipendula*).

Smooth Brome (*Bromus inermis*).—Perennial, from extensively creeping rootstocks. Stems unbranched, erect, 2 to 3 feet high; leaves abundant, long, smooth; panicles spreading when in flower, but becoming close, with the branches erect as it approaches maturity.

Although this grass has been popular in European pastures for more than a hundred years it does not appear to have attracted attention in the United States until about fifteen years ago, when it was highly recommended by the California experiment station. It was soon tested by many of the stations in other parts of the country, and nearly all of the earlier reports published were strongly in its favor. At all of the stations in the Gulf States it succeeded finely, and was thought to be of great value for winter pastures. It grows well in cool weather and bears drought. Cattle graze it with relish. In the South it is more valuable for pasture than for hay, and does better on dry than on wet soils. Although its growth on the trial plots was all that could be desired, its growth in the field has often been disappointing, and it is not gaining in general favor excepting in the Northwest. After eight years of experience with this grass on a great variety of soils it appears to be of doubtful value in the Gulf States. It has here some value for winter grazing on dry and loose soils, but its place can be better filled with other species.

Southern Canary-grass (*Phalaris caroliniana*).—Perennial; stems single or in small clumps, slender, erect, not branched, 3 to 4 feet; leaves abundant, 10 to 15 inches long; spikes erect, 3 to 6 inches long, much like those of timothy. This grass has so much the appearance of timothy that it is often called "southern timothy," though it is closely related to the true canary-grass. It is widely distributed on damp soils along the coast from Louisiana to Florida, and is valued highly for winter and early spring grazing. Attempts to cultivate it for hay have not resulted successfully, as it fails to cover the ground well. Its chief value is as a pasture grass, and for that purpose it is well worth using as a part of the mixture for wet lands.

Smut Grass (*Sporobolus indicus*).—Perennial, often in large clumps; stems slender, erect, seldom branching, soon becoming woody and tough, 2 to 3 feet tall; leaves abundant, long, and smooth; spike long and slender, usually blackened by a smut (*Helminthosporium ravenellii*).

Very common everywhere in door yards and other places where the soil is rich and has been well trampled. It is worthless as a hay grass, but as the leaves remain green through the winter, it is of considerable value for grazing, especially for horses.

St. Augustine Grass (*Stenotaphrum dimidiatum*).—Perennial by its widely creeping, flattened stems, which are much branched, and often reach a length of several feet; fruiting branches erect, 4 to 8 inches high; leaves numerous, short, rather broad and obtuse.

Common, sandy soils near the coast. A valuable sand-binder. It is frequently used as a lawn grass and makes a fair turf, but its color is too light to make it as attractive as Bermuda, and the stems and leaves are coarser.

Tall Fescue (*Festuca elatior*).—Perennial; stems usually in small clumps, rather stout, smooth, erect, 2 to 3 feet; leaves abundant, long and slender, dark green; panicle 6 to 9 inches long, loose and spreading.

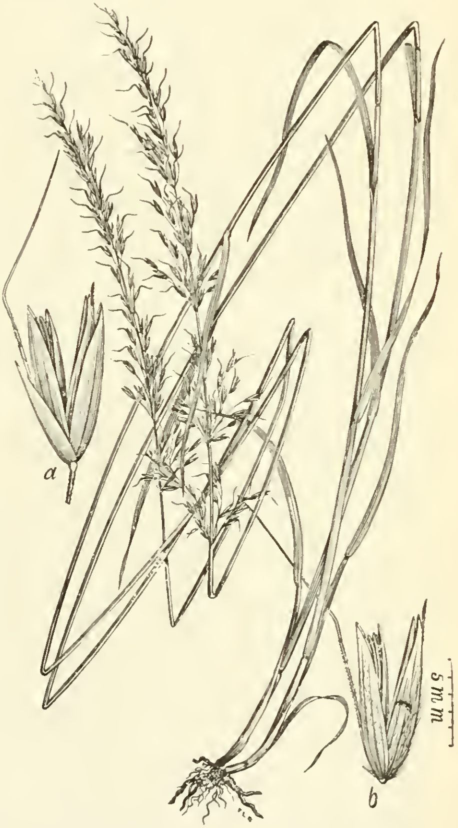

FIG. 11.—Tall Oat-grass (*Arrhenatherum elatius*).

One of the popular introduced species, sometimes known as tall meadow fescue, English blue grass, Randall grass, and by other names. It succeeds best on rather moist, rich alluvial or clay soils such as are commonly found along creek bottoms. It makes good hay, and as it remains fresh and green longer than most others, it is quite valuable for permanent winter pastures. When grown for hay it should always be mixed with other grasses on account of its habit of forming large clumps when grown alone. Redtop and alsike clover will grow well on the same kinds of soil, and the three make an excellent mixture for either meadows or permanent pastures.

Tall Oat-grass (*Arrhenatherum elatius*) (fig. 11).—Perennial; stems 2 to 4 feet tall, simple; leaves not numerous; panicle similar to that of the cultivated oat, but smaller, and the spikelets only about one-third of an inch in length.

Introduced from Europe, where it is one of the most valuable species for both hay and pasture. It is so highly prized in Europe that it has been planted repeatedly in all parts of the United States, and with widely varying results. In most cases it has been more successful in the North than in the South. Professor Scribner recommends it for Tennessee, and it has also been highly recommended for northern Alabama, Georgia, and North Carolina, but that seems to be about the southern limit of profitable cultivation. Farther south it is so weakened by the long summers that after a few years it is crowded out by other species. It grows best on a light and rather dry loam; it makes its best growth early in the season, and is easily cured for hay. It does not cover the ground well when sown alone, and for either hay or pasture should be mixed with orchard grass, perennial rye, red clover, or some other plant which will occupy the ground more fully.

Texas Blue grass (*Poa arachnifera*).—Perennial from underground rootstocks; stems scattered, erect, rather stout, seldom branched, smooth, 18 to 24 inches; leaves abundant, long, thick, smooth; panicle loose; spikelets covered with white woolly hairs.

This is emphatically a winter-growing species. In favorable location it begins its growth in October, and from November to May furnishes an abundance of luxuriant pasturage. It matures its seed in April and from the first of June until October makes but little growth. It is difficult to propagate by seed, but can be increased rapidly by means of the suckers which are produced in great numbers. A rich, loamy soil seems best suited to its growth, but in many places where the soil has appeared to be favorable its growth has been disappointing. Its only value is for winter pastures. It has given good results at the experiment stations of Mississippi, Alabama, Georgia, and Florida, but owing to the difficulty of propagation it has been very slow in coming into general cultivation.

Teosinte (*Euchlæna luxurians*) (fig. 12).—Annual; stems very numerous, sometimes 60 to 70 from a single seed, 6 to 12 feet tall. The stalks, leaves, and spindle resemble Indian corn.

This is the plant of which Prof. Asa Gray said, "Possibly affording an opportunity for one to make millions of blades of grass grow where none of any account grew before." At the experiment stations of Louisiana, Mississippi, Georgia, and Florida it has given the heaviest yields of any of the forage crops grown, Georgia reporting 38,000 pounds of green forage per acre, Mississippi 44,000, and Louisiana the enormous amount of over 50 tons. It needs a long season of hot weather, a rich soil, and abundant moisture in order to succeed well, and it is useless to plant it where all these conditions can not be had. It is a remarkably vigorous grower, reaching 10 to 12 feet in height, with an unusually abundant supply of leaves and tender stems, which continue to grow until killed by frosts. If cut when it reaches 4 or 5 feet in height it makes excellent fodder, and will produce a second crop fully as large as the first. If left to grow until September or October it furnishes excellent material for the silo, in greater amount per acre than either corn or sorghum, and there are few plants which are its equal for soiling purposes. Its leaves are similar to those of sorghum, but much longer, and the stalks contain from 8 to 10 per cent of sugar. Its value for feeding and soiling is apparent from the fact that the entire crop of 50 tons per acre grown at the Louisiana station was sold to local dairymen at the rate of $2 per ton while standing in the field. Its season of growth is so long that it seldom matures seed north of latitude 30°, but it has ripened well at the Louisiana and Florida stations. The seed, 4 to 5 pounds per acre, should be planted in hills 4 to 5 feet apart each way, about cotton-planting time, and the crop cultivated like corn. The greater distance should be given on the richer soils.

Timothy (*Phleum pratense*).—Rarely successful in any part of the Gulf States. It makes one good cutting in the spring after it is sown, but the long summer weakens the bulb-like roots so that but few plants survive until the next year.

Toothache-grass (*Campulosus aromaticus*).—Perennial from stout rootstocks; stems single or clustered, erect, unbranched; leaves long, narrow, smooth; spikes

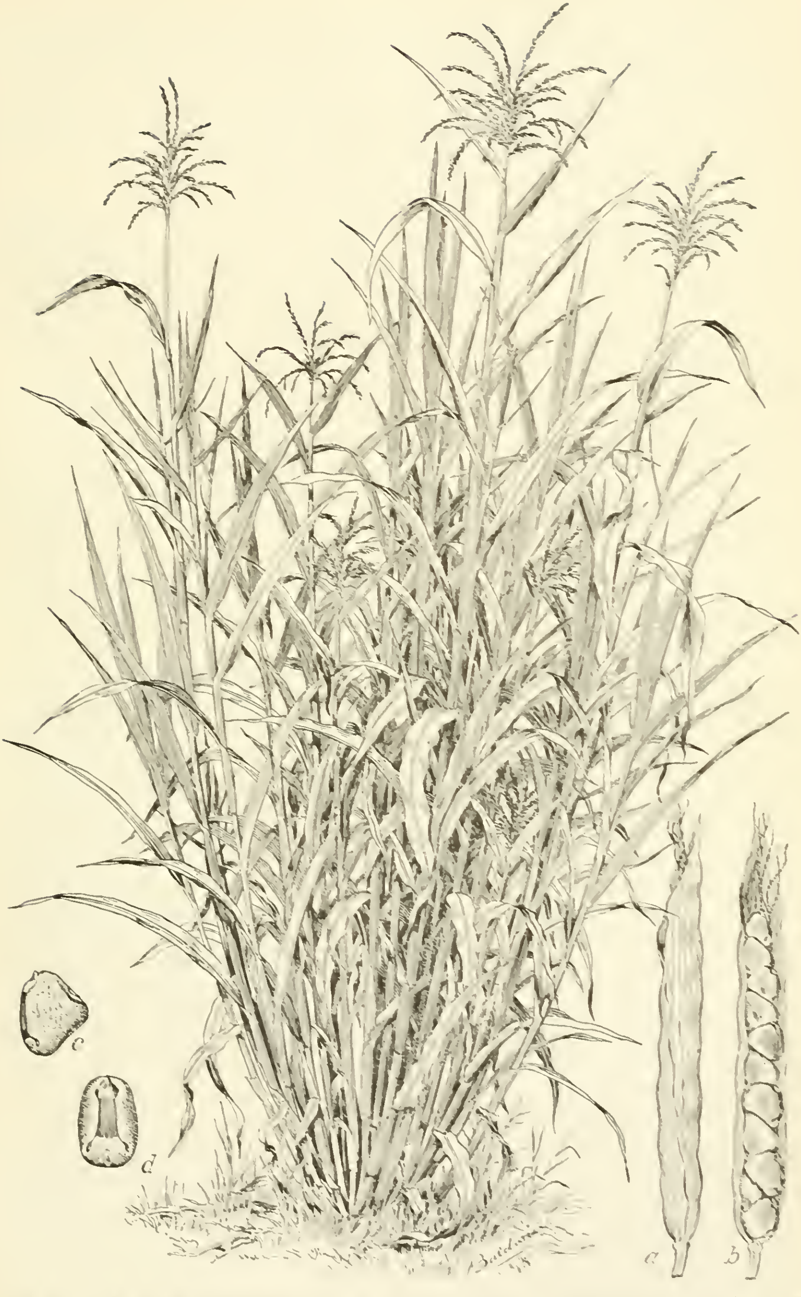

FIG. 12.—Teosinte (*Euchlæna luxurians*): *a*, one of the "ears" inclosed by the "husk"; *b*, the same with a portion of the husk removed, showing the grains; *c* and *d*, views of the grain.

terminal and at right angles to the stem, becoming curved when old; spikelets with awns one-fourth of an inch long.

Common on wet pine barrens, and one of the most conspicuous of the native grasses. The rootstocks, when mature, have a pungent, aromatic taste, and chewing them is said to be a remedy for toothache. The whole plant is more or less aromatic, and is rarely eaten by stock

Velvet-grass (*Holcus lanatus*).—Perennial; often in large clumps; stems erect, not branched, 1 to 2 feet high; leaves very numerous, long, and wide; panicle 2 to 3 inches long, erect, compact, often tinged with purple; whole plant clothed with soft white hairs, which give it a very striking appearance.

This is one of the European grasses which has been highly recommended and extensively planted, but has rarely been successful in the Gulf States. It sometimes remains fairly permanent on thin soils where it is not crowded by other sorts, but is never eaten well by stock. On richer and moister soil it is often seriously affected by one of the same rusts which attacks oats. It should be sown only when in mixtures and on thin soils.

Water-grasses (*Paspalums*).—The Paspalums rank next to the panic grasses in importance and in number of species in the native pastures, 36 being found in the South. Like the panic grasses, very few are of much value for hay. The group furnishes several of the best pasture grasses, however, and some of these are well worth cultivating. Most of the species prefer a moist soil, and though they are often found on soils which are quite sandy, they are rare on dry clay hills. Most of them are perennial, and several bear cold so well that they are of considerable importance in winter pastures.

CARPET-GRASS (*Paspalum compressum*).—Perennial; stems erect or decumbent, extensively creeping and rooting at the joints, upright stems 6 to 18 inches; leaves very numerous, short, obtuse, smooth; peduncles long and slender, terminated by 2 to 4 very slender spikes 1 to 2 inches long, similar to those of crab-grass.

This is apparently indigenous along the coast, and is slowly spreading northward, being now somewhat common in central Mississippi and Alabama. It is undoubtedly the best pasture grass we have for sandy soils, and it will bear more hard trampling and close grazing than will any other species. On heavy soils it is often crowded out by Bermuda and other species, but on light soils of even moderate fertility it will soon cover the ground, to the exclusion of all others. It is a grass which soon comes in when sandy soils are pastured closely and will choke out the broom-sedge and other less desirable sorts. It is easily destroyed by plowing and never becomes a weed. It rarely grows large enough to be cut for hay, though on the prairies of southwestern Louisiana, where it is known as "*petit gazon*" it reaches a height of 2 feet or more and covers a large part of the native meadows. The seed is rarely found in the market, but the plant is easily propagated by mowing when the seed is ripe, and scattering the hay over the field where the grass is wanted. Even if but few plants should appear the first year, the seeds will soon be spread by stock so as to cover the entire field. It bears heavy frost without injury, and so affords considerable grazing during the entire winter. It is often used as a lawn grass on soils too light and sandy for Bermuda, and is excellent for that purpose, though its rather light color makes it less attractive than a grass having a richer green.

HONEY DEW (*Paspalum plicatulum*).—Perennial, though often growing as an annual; stems, many from a single root, much branched, spreading or erect, smooth, 2 to 3 feet; leaves numerous, rather long, nearly smooth; spikes 4 to 10, spreading, 2 to 3 inches long, hairy on the axils; spikelets usually in 4 rows; stems and leaves usually purple in color.

Common on moist and heavy soils, though often found in dry places. In habit of growth it is much like crab-grass, coming up in cultivated fields after other crops have been laid by, and making a good yield of hay, which is sweet and well liked by stock, but is slow in curing. This is one of the prominent species in the native meadows of the Louisiana prairies, and is one of the more abundant sorts eastward to Florida, often covering entire fields from which oats, melons, or other early crops have been harvested.

Knot-grass (*Paspalum distichum*).—Perennial; stems creeping extensively and rooting at the joints, with ascending or erect branches 6 to 12 inches tall; leaves very numerous, short, small; spikes usually 2, divergent, 1 to 2 inches long.

A grass having much the same habit of growth as carpet-grass and Bermuda, but confined to very moist soils on the borders of ponds or streams and similar locations. It is very common in ditch bottoms, where it is sometimes quite troublesome, as it catches the sediment from the running water and soon fills the ditch. Both stems and leaves are quite succulent and tender, and are grazed closely during the late summer, but as it is killed down by moderate frosts it is of but little value for winter pastures.

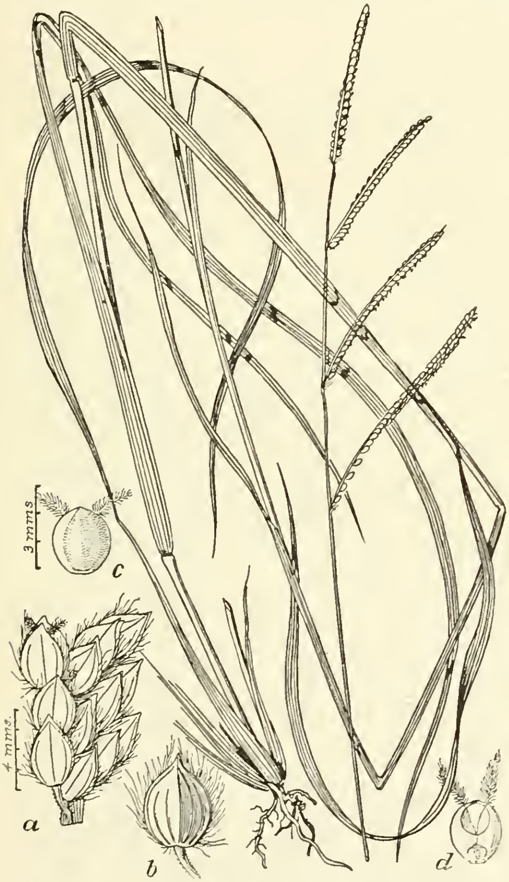

Fig. 13.—Large Water-grass (*Paspalum dilatatum*).

Large Water-grass (*Paspalum dilatatum*) (fig. 13).—Perennial; stems in clumps, erect, seldom branched, smooth, 3 to 4 feet; leaves very numerous near the ground, fewer on the stems, a foot or more in length; spikes 4 to 7, erect or spreading, 2 to 4 inches long, with a small cluster of white hairs on the axils; spikelets pubescent.

A rather coarse grass, which grows best on rich and rather damp soils. It spreads slowly from the roots, but seeds freely, and when once started will soon cover a field where the soil is suited to its growth. The stems are rather coarse for hay unless cut early, but it produces a very large amount of long and broad leaves, which remain fresh and green during the entire winter. It withstands the longest droughts without injury, bears grazing well, starts its new growth early in the spring, and is one of the best pasture grasses. Its habit of growing in clumps is an objection to its use for hay, but it is an excellent variety for mixing with redtop, as it grows best on the same character of soil and largely increases the yield.

Wild Barley (*Hordeum nodosum*).—Annual; stems single or in small clumps, geniculate at the base and becoming erect, smooth, 9 to 12 inches high; leaves abundant, short and narrow; spikes slender, 2 to 3 inches long; spikelets bearded, soon falling apart.

This is often abundant in early spring on hard clay soils which are heavily tramped. It gives a little good grazing in March, but is not eaten after the heads begin to show, and by May the stems are dead and dry. Little more than a worthless weed.

Wild Rye (*Elymus*).—There are three species of wild rye which are rather common throughout the South. All grow in stools similar to those of wheat or oats, with erect stems 3 to 5 feet high; leaves and spikes like those of rye.

Rather coarse grasses, common along fence rows and creek bottoms, where the soil is rich and somewhat damp. The Canadian wild rye (*E. canadensis*) is the tallest and coarsest of the three, and has but little value. Dennett-grass (*E. striatus*) is more valuable, but not as good as the Terrell-grass (*E. virginicus*). The latter grows in woodland pastures and furnishes a large amount of grazing through the winter and early spring.

Woodland Bunch-grass (*Eragrostis glomerata*).—Perennial; often in large clumps; stems slender, erect, smooth, 1 to 2 feet; leaves numerous, slender, rather short; panicle sometimes a foot in length, slender and compact, producing a very large amount of seed.

This is an excellent summer grass for moist woodland pastures, often growing on the edges of marshes and other damp locations where but few good grasses are found. Cattle appear to be very fond of it, and it is doubtless worth planting in pastures. This is almost the only species of *Eragrostis* which is of value found in the Gulf Sates.

MISCELLANEOUS FORAGE CROPS.

Alfalfa (*Medicago sativa*) (fig. 2).—One of the most common cultivated forage plants of the West, and rapidly coming into favor in the South. It is a very deep-rooted plant which bears drought well, but the roots can not endure stagnant water or sour soil, so that it must always be grown on lands which have good drainage. It is a very prolific hay plant, as it will give from two to four, or more, cuttings annually, each cutting making from 1 to 2 tons of hay. It should be cut as soon as it comes into bloom, or before the stems become hard and woody. The hay should be handled as little as possible, as the leaves drop off very easily, and when badly handled the hay is little more than coarse stems. Well-made hay has about the same value as that from red clover. As a pasture plant it is good for horses, mules, and sheep, but not safe for cattle, as it occasionally causes bloating. It is one of the best plants for a summer hog pasture, and also affords considerable winter grazing. The greatest difficulty in growing it is in securing a good stand. The land on which it is to be sown should be put in the best possible condition, and seeded in September at the rate of 15 to 20 pounds per acre, though good results are often secured with 10 pounds of seed. The ground should be rolled after sowing. On most lands crab-grass and weeds will come up thickly with the alfalfa, but will be killed by the first heavy frosts, and by spring the alfalfa will be strong enough to smother other growths.

Seeding may also be done in the spring, but if the field is not watched many of the alfalfa plants will be smothered by grass and weeds. If weeds threaten to injure the stand, the field should be mowed, setting the mower as high as possible to avoid cutting the young alfalfa, after which it will usually be strong enough to protect itself. When a stand is once secured it is permanent. Professor Newman, director of the South Carolina experiment station, states that he has known a field of alfalfa to give good crops fourteen years in succession in Alabama, and twenty-five years in Georgia. It springs up quickly after each cutting, and Dr. Taliaferro, of Orange County, Fla., states that he has cut five crops within twelve months from seeding, while Dr. Stubbs, of the Louisiana station, reports fourteen cuttings in eighteen months from seeding. Farther north it is less prolific, but is everywhere one of the best soiling crops.

Alsike Clover (*Trifolium hybridum*).—Perennial; intermediate between the white and red clovers in habit and appearance.

Alsike is the best of the clovers for wet grounds, but is of no value on dry soils. On the borders of marshes, seepy hillsides, and places too wet for other clovers this makes its best growth. It seldom grows sufficiently large to make a good yield of hay, but is an excellent pasture plant, and should always be sown with redtop on the damp places in a permanent pasture. Sow 6 pounds of seed per acre in September or March.

Artichoke (*Helianthus tuberosus*).—Perennial, by underground tubers; stems erect, 5 to 8 feet; leaves and flowers much like those of the ordinary sunflower, but smaller.

One of the best and most profitable crops for winter hog pastures. The tubers may be cut in small pieces for planting, as is done with Irish potatoes, and about the same amount of "seed" per acre is required. They are planted in the same manner and require the same cultivation as the Irish potato. The tubers make very little growth before October, and do not become thoroughly matured before December. The yield is larger than that of any other root crop, being ordinarily from 400 to 600 bushels per acre, while double those yields are secured under specially good conditions. When the crop is fully matured a few rows should be plowed out to secure "seed" for spring planting, and this should be buried like potatoes. When the field is turned over to the hogs enough of the tubers will be left in the ground to restock the field, but as the hogs will leave the ground very rough and uneven, and the plants will be so irregular that they can not be cultivated, it is much better to plow the entire field in the spring and replant in regular rows. When it is desired to clear a field in which artichokes have been grown it can be accomplished by a single plowing in June or July, after the new growth has exhausted the old tubers and before the new crop has formed.

Birdfoot Clover. Yellow Trefoil (*Lotus corniculatus*).—Perennial; stems branching, slender, nearly prostrate, 3 to 12 inches; leaves very numerous, small; flowers yellow, in small heads.

This grows well on hard and sterile soil, roots deeply, bears drought well, and is of considerable value as a pasture plant. It begins its growth very early in the spring, but is little esteemed after the beginning of summer. It is well worth sowing in dry pastures.

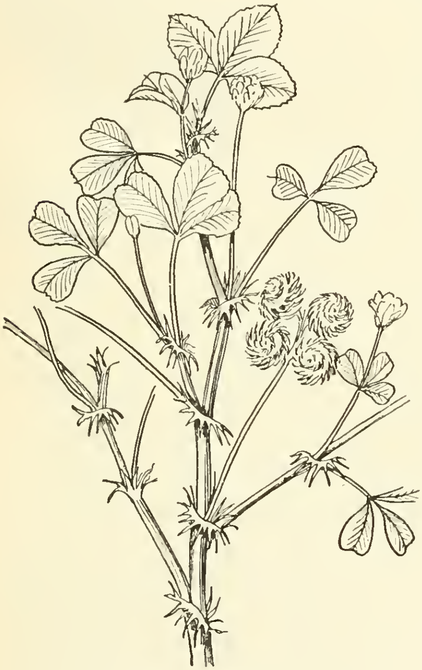
FIG. 14.—Bur-clover (*Medicago maculata*).

Buffalo Clover (*Trifolium reflexum*).—Annual or biennial; stems in large clumps, erect, downy, 9 to 12 inches; leaflets roundish or obcordate; flowers nearly white; calyx reflexed when mature.

Very similar to red clover in appearance, excepting in size and color of flowers. It is widely distributed, being more common along fence rows and ditch banks than elsewhere, and is nowhere abundant. It is a good grazing and hay plant, but grows so poorly in open fields that it is not profitable for cultivation.

Bur-clover (*Medicago maculata* and *M. denticulata* (fig. 14).—Annual; stems branching, decumbent, 1 to 3 feet; leaves very numerous, large, tri-foliate, each leaflet with a dark brown spot in the middle; flowers small, yellow, in small heads on long peduncles; seeds in a small bur.

Extensively introduced, and a valuable pasture plant for early grazing. Eaten well by cattle and sheep, and occasionally by horses and mules; of little value for hay. Seed should be sown in October, on rich loamy soil, and the plants will make good grazing by February or March. The seed matures in April and May, after which the ground may be plowed and cultivated in other crops during the summer. The clover seed will remain in the ground, and if the field is cleared of its summer crop by October no reseeding will be required. An excellent plant to mix with Bermuda on a calf pasture.

Bush Mallow (*Sida elliottii*).—Perennial; stems slender, erect, 2 to 3 feet; branches long and straight; leaves very narrow; flowers yellow, 1 inch wide.

Rather common in dry, open woods, and eaten well by cattle, probably for its mucilaginous seeds, even late in the season after the stems become dry and hard. Not worth cultivating.

Butterfly Pea (*Clitoria mariana*).—Perennial; stems erect or twining, 2 to 4 feet; leaflets 3, ovate-oblong; flowers pale blue, 2 inches in diameter; legumes 1½ to 2 inches long.

Common on dry, woodland soils, and yields nutritious grazing, but is too scattering to be of much value.

Canada Field Pea (*Pisum arvense*) (fig. 15).—An annual, much like the common garden pea. It has been planted at many places in the Gulf States, but has never proved valuable. When sown in the fall its growth is not equal to that of the vetches, while if sown in spring it suffers severely from mildew.

Carolina Clover (*Trifolium carolinianum*).—Perennial; stems tufted, prostrate, 6 to 10 inches; leaflets small, obcordate; flowers white, tinged with purple; calyx reflexed when mature. Common on dry clay soils, making its growth early in the spring and soon disappearing; valuable only because it gives a little early grazing on soils too poor for most other plants.

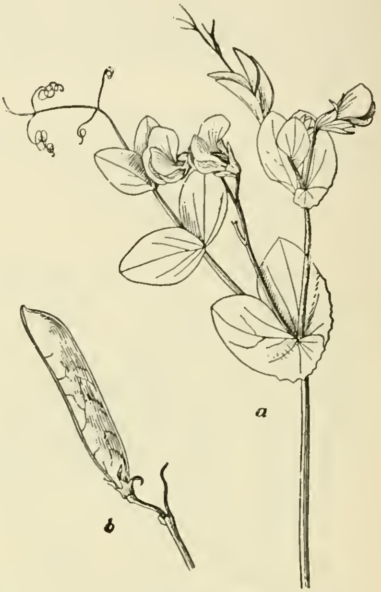

FIG. 15.—Canada field pea (*Pisum arvense*).

Cassava (*Manihot aipi*) (fig. 16).—Perennial; stems erect; branching, 4 to 6 feet; leaves large, palmately compound; roots 3 to 5 feet long, 1 to 2 inches in diameter, and very starchy. A native of the tropics, but recently introduced in Louisiana and Florida. On fertile soil it is said to yield as much as 10 tons of roots per acre, and the roots are worth fully as much as potatoes for feeding. The plant is propagated by planting short cuttings of the stems, and requires only ordinary cultivation. As the roots decay quickly after being taken out of the ground, they should be dug only as wanted for use.

Chinese Yam (*Dioscorea batatas*).—A perennial twining vine, often reaching a length of 20 feet; leaves heart-shaped; flowers small, white, in rather dense clusters.

The roots are quite large, club-shaped, often reaching 3 feet in length with a diameter of 3 inches at the lower end. They are starchy and mucilaginous, and make a food fully as rich as sweet potatoes, but their peculiar shape makes them hard to dig. The plant is propagated by means of small tubers which are produced in immense numbers in the axils of the leaves, and on a rich loamy soil the yield of these tubers is often fifty or more bushels per acre. These tubers remain on the surface of the ground uninjured during ordinary winters, and so are a valuable winter food for hogs.

Chufa (*Cyperus esculentus*).—A perennial sedge that produces a large yield of small tubers which are a valuable food for hogs. It grows best on a sandy soil which has been well fertilized, where it makes a yield of from 75 to 100 bushels per acre. The tubers are planted in early spring, 12 to 15 inches apart in rows 3 to 4 feet apart, and the only cultivation needed is to keep down grass and weeds. The tubers mature in October and November, and are easily rooted out by the hogs. Of little value on heavy soils.

Cowpea (*Vigna catjang*).—Well-known annual of unknown origin; cultivated throughout the South for more than one hundred years. Some varieties mature within sixty days from planting, while others will continue to grow until killed by frost. In planting it is better to select varieties which will mature a good part of the seed before time for frost. The heavier yield is secured by planting in drills and cultivating, but when seed is cheap and labor scarce a less expensive crop can be made by sowing broadcast. The better farmers always plant peas between the rows of corn at the last plowing, and the crop is one which can be grown with profit during any two months of warm weather when the land would otherwise be idle.

Crimson Clover (*Trifolium incarnatum*).—Annual; stems erect, somewhat branching, 1 to 2 feet; leaves numerous, obovate, rather large; flowers bright crimson, in long spikes.

Introduced from Europe; a valuable plant in nearly all of the country east of the Allegheny Mountains from New Jersey to Georgia, but has rarely succeeded well in any of the Gulf States. Seed should be sown in September or October at the rate of 20 pounds per acre, and where it grows well it can be grazed during the winter or cut for hay in the spring before the seed begins to mature. The plant has not proved generally valuable west of the Alleghanies, and in the South has rarely made a crop of any value, as the plants usually die during early winter. The matured plant is dangerous for feed as the stiff hairs on the calyx form balls in the stomachs of animals and often cause death.

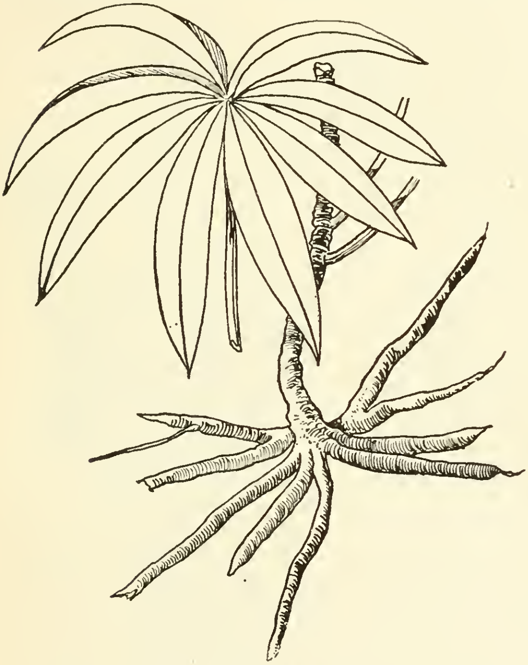

FIG. 16.—Cassava (*Manihot aipi*).

FLAT PEA (*Lathyrus sylvestris wagneri*).—Perennial; much like winter vetch in appearance.

This was introduced from Europe a few years ago, and extravagant claims were made for its luxuriant growth on the hardest and most sterile soils. It has been tested repeatedly at each of the Southern experiment stations and by hundreds of farmers, but has been uniformly disappointing. Its growth the first year from seed is rarely as much as 12 inches, and it requires the best of care to make it survive the summer. Older plants are more hardy and vigorous, but fail to hold the ground against native grasses and weeds, and soon disappear.

FLORIDA BEGGAR-WEED (*Desmodium tortuosum*).—Annual; stems erect, branching, 4 to 7 feet; leaflets 3, rhombic or elliptical, tomentose beneath, rough above; flowers small; legumes 1 to 1½ inches long, 3 to 6 jointed, rough-hairy.

Very common on sandy soils in Florida, and extending into South Georgia and Alabama; often planted and becoming naturalized along the coast farther west.

This is the best leguminous forage plant which has been found for light sandy soils, and it makes a vigorous growth on soils too light for most other crops. Its principal use is as a grazing plant, stock of all kinds grazing it freely and fattening rapidly where the plant is abundant. As it does not begin its growth until late in the spring and is killed by moderate frosts, it is valuable only during the summer and fall. It often grows as a volunteer with crab-grass and crowfoot on cultivated lands, and is then cut for hay. When used for hay, it should be cut when only 2 or 3 feet high, as the stems become hard and woody as the plant grows older. Besides its use as a hay and grazing plant it is a valuable fertilizing crop, and the seed is often scattered in corn fields at their last cultivation. When sown for hay, from six to eight pounds of seed are used per acre, and after land has once been seeded it seldom needs reseeding, though the plant never becomes a troublesome weed.

Several other species of *Desmodium* are found, usually in dry woodlands, throughout the entire region. Among the more common of these are *D. acuminatum, nudiflorum, pauciflorum*, and *viridiflorum*. All are eaten fairly well and add considerably to the woodland pastures, but are rarely abundant.

Groundnut (*Apios tuberosa*).—Perennial; stems climbing; leaflets 5 to 7, ovate or ovate-lanceolate; brownish-purple flowers in axillary racemes. Common in wooded swamps from Mississippi to Florida and northward. Eaten by all kinds of stock, hogs being very fond of the small tubers on the roots.

Hog Peanut (*Amphicarpæa monoica*).—Perennial; climbing; leaflets 3; flowers of two kinds—those on the stems in drooping racemes and sterile, those at the base fertile, fruiting underground. Occasional in rich, damp woods from Mississippi to Florida and northward. The vines are eaten by cattle, and hogs are fond of the underground nuts.

Horse Bean (*Faba vulgaris*).—Annual; stems erect, 2 to 3 feet; leaflets 3, oval, smooth and glaucous; flowers in small axillary clusters; pods 2 to 4 inches long.

Highly prized in Europe, but not successful here, as the plants are usually destroyed by blight at about the time they begin to bloom.

Jack Bean (*Canavalia ensiformis*).—Annual; stems erect, bushy, rather stout; leaflets 3, large; flowers few, in dense axillary racemes; pods 3 to 6 in a cluster, a foot or more in length; seeds large, white.

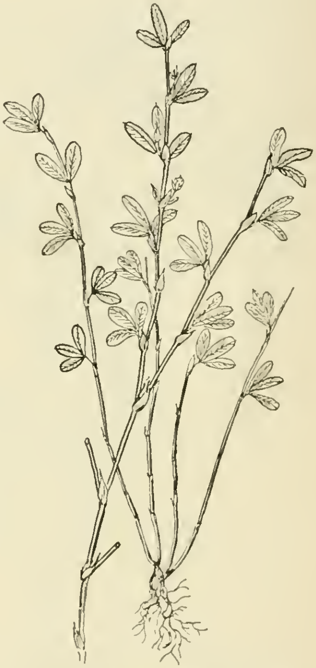

FIG. 17.—Japan clover (*Lespedeza striata*).

This came into notice about 1890, and since then has been planted in many places. The growth of the plant is all that could be asked, and the yield of beans is from 30 to 50 bushels per acre; but, unfortunately, neither the beans nor the plants are eaten well. At the Mississippi station the beans were fed in many ways—dry, soaked, ground into meal, and cooked—but neither horses, mules, cattle, nor hogs would eat them.

Japan Clover (*Lespedeza striata*) (fig. 17).—Annual; stem branching, slender and wiry, 3 to 24 inches; leaves very numerous, small; flowers small, in axillary clusters. This may be classed among the most valuable leguminous hay and pasture plants of the Gulf States. It is a native of Japan, which was introduced into this country about 1830, and is now thoroughly naturalized over the whole country south of the Ohio River. It grows on all soils, but does best on good loams containing a fair amount of lime. It will also grow on hard, dry clay, and even where the soil is quite sandy. On thin soils its growth is very flat and spreading, while on better soil it becomes erect, and is often 2 feet in height. It endures heat and drought without injury, and stock eat it greedily. It never causes bloating, but occasionally has a slight salivating effect on horses, though that appears to occur in only a few localities. It starts late in the spring, but from May until after heavy frost it gives the best of grazing, and should be in every pasture. Although mostly used for grazing it is a valuable hay plant, making a good yield of from 1½ to 2 tons per acre. When wanted for hay, it should be sown in early spring, at the rate of one-half bushel per acre, or it may be sown with oats in the fall, as it makes but little growth before the oats are harvested. For pastures it is necessary only to scarify the surface of the ground with a disk harrow, and it will often grow well without any previous preparation of the soil. There are a number of native species of lespedeza which are quite common in dry, open lands throughout the South, and although all are grazed, they are not worth cultivating.

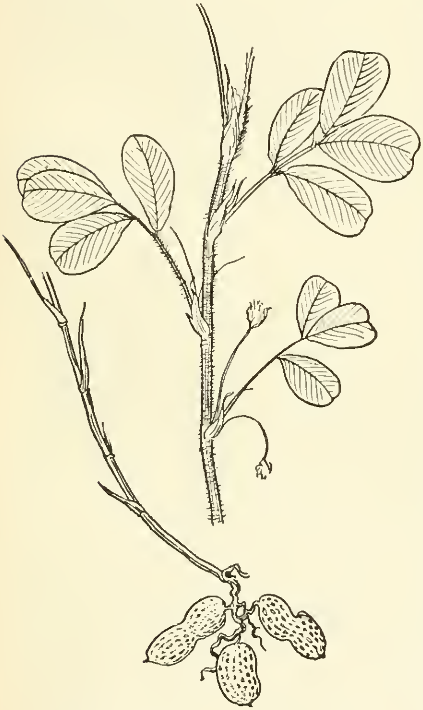

FIG. 18.—Peanut (*Arachis hypogea*).

Kidney Bean (*Phaseolus diversifolius*).—Annual; stems prostrate or trailing, slender, 2 to 4 feet; leaflets 3, oval or 2 to 3 lobed; flowers purple, on long peduncles; pods long and slender.

Common on dry, sandy soil, affording some summer and fall grazing, but hardly worth cultivating.

Three other species of the same genus are quite widely distributed throughout the South, but are not sufficiently abundant to be of much importance.

Mexican Clover (*Richardsonia scabra*).—Annual; stems branching, diffuse 2 to 4 feet; leaves numerous, oval, rough; flowers nearly white, in small heads.

This is not a true clover, but takes its name from its habit of growth, which is much like that of red clover. It is a native of Mexico and Central America, but has become thoroughly naturalized along the Gulf coast, and is found occasionally as far north as central Mississippi and Georgia. A sandy soil seems essential to its vigorous growth in cultivated fields after other crops have been laid by. Where this and crab-grass grow together on well-fertilized soils the yield of hay is often two tons per acre, and costs nothing but the cutting. Feeders are somewhat divided as to its value, some claiming that it makes hay of fine quality, while others declare it to be worthless. Chemical analysis of the hay indicates that it is nearly or quite as rich a food as red clover, and it is certain that many animals keep in good condition through the winter with no other feed. It has but little value for grazing.

Milk Pea (*Galactia glabella*).—Annual; stems prostrate, 2 to 3 feet long, very slender; leaflets 3, rather rigid, 1 inch long; flowers large, reddish purple, 3 to 6 in a cluster.

Common on dry pine barrens and eaten well, but scarcely worth cultivating.

Eight or ten other species of *Galactia* are more or less abundant, usually in dry woods.

All are eaten freely, but their growth is too thin and scattering to make them of much value.

Peanut (*Arachis hypogæa*) (fig. 18).—Of some value for hay, and cultivated for hog pastures in all parts of the South. There are two very distinct types in cultivation, the "common" and the "Spanish." The former is the one which produces the peanut of commerce. The plant grows as straggling as a potato, and the nuts are produced on long peduncles and often quite scattered. This is seldom used for hay, though often grown for hogs. The Spanish variety is a smaller, more compact, and erect plant, which produces an immense number of very small nuts clustered closely at its base. This variety is growing in favor for hay, as the plant with its closely adhering nuts is easily pulled up. The yield is from 1 to 2 tons per acre, and as nearly half the weight is in the nuts, the hay is richer in protein than any other in common use. Either variety makes fine fall pasturage for hogs, and as the hogs do the harvesting, peanuts furnish the cheapest food for the season.

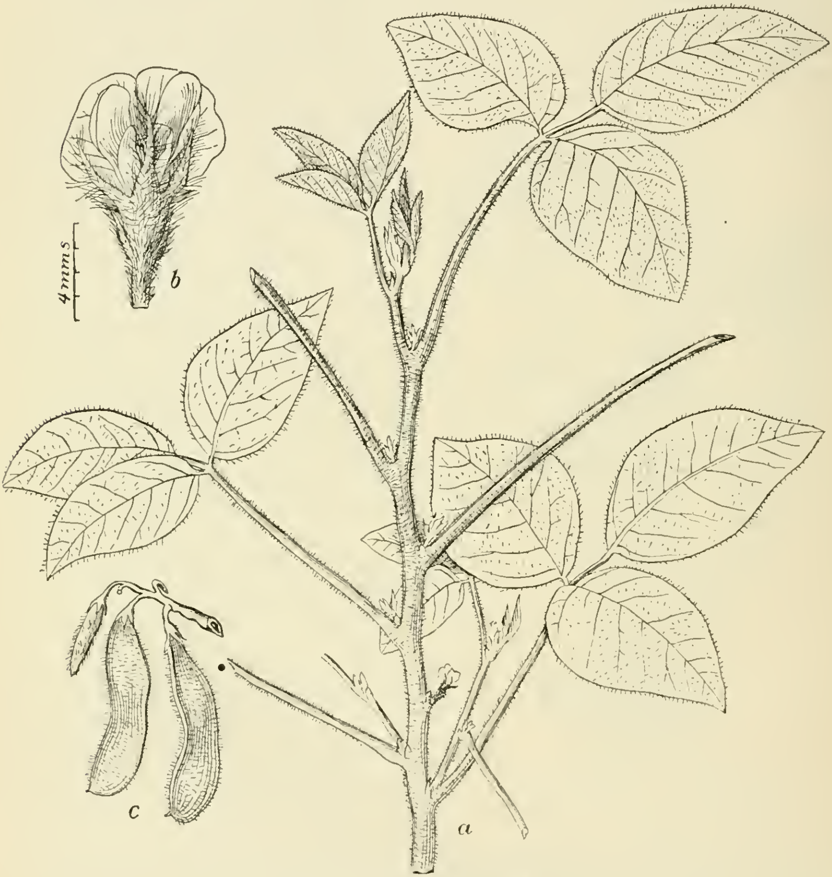

Fig. 19.—Soy Bean (*Glycine hispida*).

Prickly Comfrey (*Symphytum asperrimum*).—Perennial; stem erect, coarse, 2 to 4 feet; leaves very large and abundant, rough.

A very rank-growing plant which has been highly recommended for forage, especially for soiling. It is propagated by cuttings of the roots, which are planted about 18 inches apart in each direction and which continue to produce heavy crops of leaves for several years. Cattle do not eat the leaves readily until they become accustomed to them, and there are other plants which are more profitable in the South.

Ramie (*Boehmeria nivea*).—Perennial; stem erect, coarse, 2 to 4 feet; leaves numerous, large; flowers very small and inconspicuous, in axillary clusters.

Although this is ordinarily cultivated as a fiber plant, it is grazed well by cattle and is an excellent crop for soiling. On rich soil it will give from three to six cuttings of the stems from 2 to 4 feet in height, and if cut before becoming mature they are so tender that the entire stalk is eaten. It is profitable only on rich soil, and does much better near the coast than farther north, as it needs a long season with abundant rains.

Red Clover (*Trifolium pratense*).—Red clover is becoming more popular each year, and is now quite a common crop in the black prairie region and in other sections where the soils contain a fair amount of lime. It requires a soil which is rich and in fairly good condition to insure a "catch" of the seed. On many soils where it makes a good start and yields two or three cuttings it soon becomes overrun with other plants and is choked out. It is the best of the family to occupy a good soil two or three years, but is of little value on poor soils. Seed should be sown in September at the rate of 10 to 12 pounds per acre, and it will then give a heavy cutting the following May. It succeeds best in the South when sown with no nurse crop.

Sedges (*Carices*).—Very similar to the true grasses in general appearance, but with the stems 3-angled and the leaves 3-ranked, while among the true grasses the stems are nearly round and the leaves are 2-ranked.

Usually on soils which are too wet and heavy for most of the true grasses, very common in swamps and tide marshes; nearly all are grazed when young, but as they approach maturity most species become so tough and tasteless that they are not touched by stock. The hay made from them is of poor quality, and one of the species is worth cultivating.

Soy Bean (*Glycine hispida*) (fig. 19).—Annual; stem stout, erect, branching but little, 2 to 4 feet; leaflets, 3; flowers in axillary clusters; pods short, 2 to 4 seeded; whole plant rough-hairy.

One of the staple crops of Japan, which attracted little attention in this country until about ten years ago, but is now becoming quite common. The crop is cultivated like corn, the seed being planted in drills at the rate of half a bushel per acre. The stems alone are too coarse to make good hay, but are covered with such a dense growth of leaves and are so prolific in fruit that the hay is prized highly, especially for milch cows and for fattening animals. The yield of green forage is very heavy when grown on good soil, and the yield of beans is from 20 to 30 bushels per acre. Those who have had most experience with this crop find that the best way to handle it is to cut or pull the plants when the first pods begin to open, and thrash as soon as dry enough. In this way the coarse stalks are so broken in pieces and mixed with the leaves and immature fruit that nearly all will be eaten. It is doubtless the best of the legumes for the silo, as it can be more easily handled for the cutter than can plants like clover or cowpeas. There are a number of varieties, differing mainly in the time of ripening and the color of the seeds.

Spurred Butterfly Pea (*Centrosema virginiana*).—Perennial; stems twining, 3 to 5 feet; leaflets, 3; flowers on short axillary peduncles, blue or purple, 1½ inches long; legumes, 4 to 6 inches long.

Common on dry soil in woods; eaten well, and might be worth planting in woodland pastures.

St. John's Bread; Carob Bean (*Ceratonia siliqua*).—A tree which is grown rather commonly in Florida, and occasionally farther west. It is valued for its sweet, fleshy pods, which are very rich in sugar, and so are good feed for fattening stock.

Sulla (*Hedysarum coronarium*).—Perennial; stem erect, branched, 4 to 6 feet; leaves very numerous, pinnate; flowers in large showy clusters.

A very deep-rooting plant which grows best on a well-drained soil. It makes a heavy yield in early spring, but is so tender that it can not be recommended except in Florida, as the plants are killed by frosts.

"When sown in the fall it makes an enormous growth during the winter, which is slightly injured by very severe frosts without being killed. Scarcely hardy enough for a winter crop, and yet not successful as a summer one."[1]

Sweet Clover (*Melilotus alba*).—Biennial; stems erect, widely branched, 3 to 5 feet; leaves abundant, tri-foliate; leaflets elliptical; flowers white, in slender spikes.

Common where the soil is rich in lime. Even on the white, rotten lime-stone hills in the black prairie region, where no other plants can grow, this makes a good yield. Its growth is much like that of a coarse alfalfa, but it will grow well on a much poorer soil and on one which is in poor mechanical condition provided it has an abundance of lime. It may be sown with Johnson grass, when it will make one cutting before the grass has much growth, and the later cuttings are heavier than when either plant is grown alone. It is an excellent pasture plant, beginning its growth in early spring. Cattle not accustomed to it do not always eat it readily at first, but if turned into the pastures before other vegetation furnishes much grazing they soon acquire a taste for it. The roots are very large and deep, and as they decay at the end of the second season they are fine fertilizers. Seed may be sown in either October or February. Usually but one cutting of hay can be made the first year, but the second season it will make three good cuttings. Although a biennial, a few plants will produce seed the first year and a few will live three years, so that land needs to be seeded but once to secure continuous occupancy by melilotus.

Sweet Potato (*Convolvulus edulis*).—The ranker-growing and coarser varieties of sweet potatoes are used largely for hog pastures, as the crop is one which can be grown with very little expense, and the harvesting is done by the hogs. The yield is often 200 bushels per acre, and the crop is one of the best and the cheapest that can be grown on sandy soil. The vines are sometimes saved for hay, but are hard to cure.

Velvet Bean (*Mucuna utilis*).—Annual; climbing stems sometimes 50 feet in length; leaflets 3, large; pods numerous, 2 to 3 inches long, each containing 3 or 4 large oval beans.

A newly introduced plant which has not been extensively tested, but which has been highly recommended by the experiment stations of Louisiana and Florida.

Vetches.—Six species of vetch are native to the Gulf States, two or three of which are very widely distributed, being quite common in open woods and along creek banks. All make their growth in late winter and early spring, and often are so abundant as to make considerable early grazing. None of the native species are worth cultivating as a field crop, but when seed can be gathered without too much labor it will pay to sow it on pasture lands.

DWARF VETCH (*Lathyrus pusillus*).—Annual; stem slender, nearly erect, 12 to 18 inches; leaves pinnate; peduncles long, 1- or 2-flowered; pods long, 12- to 15-seeded.

Common along roadsides and on dry soils. Good early grazing, but too dwarf for profitable cultivation.

HAIRY VETCH (*Vicia villosa*) (fig. 20).—Annual; stem straggling, much branched, 8 to 12 feet; leaves pinnate, very numerous, flowers purple, in erect racemes.

The best of the winter-growing legumes on a rich loam soil, but usually a failure on sandy lands. Seed should be sown in September or October at the rate of 1 bushel per acre. The growth is weak until January, when it begins to grow vigorously, and by March will usually make a mass of forage 2 feet deep. The seed matures in May or June, and the crop should be cut for hay as soon as the first pods ripen. The ground may then be plowed and cultivated for summer crops to be gathered by October, when the vetch seed scattered by the mowing will germinate and again cover the ground. The crop may be used either for grazing or for hay, and the yield of either is largely increased if oats are sown on the same ground.

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[1] Bul. No. 19, Louisiana experiment station.

Spring Vetch or Tares (*Vicia sativa*).—Annual; stems trailing, pubescent, 1 to 2 feet; leaves variable in shape, from obovate to linear; flowers axillary, in pairs, nearly sessile.

An introduced plant which is of considerable value for winter grazing and for growing with winter oats, but less prolific than the hairy vetch.

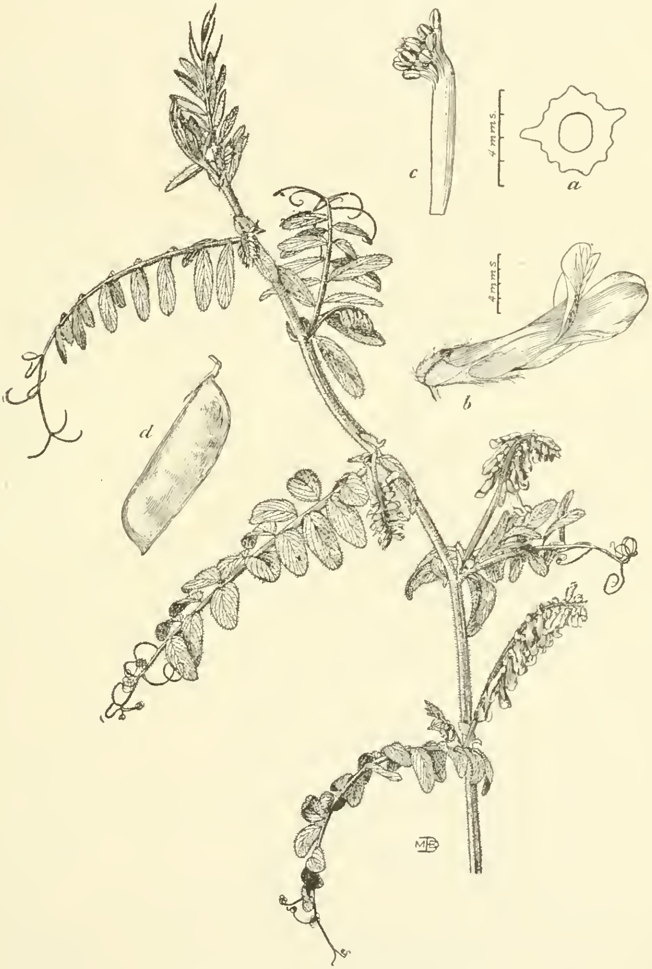

Fig. 20.—Hairy Vetch (*Vicia villosa*).

Winter Vetch (*Lathyrus hirsutus*).—Annual; stem climbing or straggling, branching, 2 to 4 feet; leaves 3 to 6 in cluster; pods short, 2 seeded.

Introduced and naturalized in many places. Seed sown in September or October will germinate with the first autumn rains, though the plants make but little growth before January or February, after which they grow rapidly and cover the ground with a dense mass of forage by March or April. The plants bear grazing well, and reseed the ground freely. They will not bear quite as much frost as will the hairy vetch, but are eaten fully as well, and seem to be preferred by horses, though not by cattle. An excellent winter and spring pasture plant.

White Clover (*Trifolum repens*).—Uncertain and unreliable in its growth, sometimes covering the ground with a thick mat of vigorous plants, and then often disappearing for several seasons. A good grazing plant for cattle, but thought by some to be injurious to horses and mules.

Yellow Lupine (*Lupinus luteus*).—Annual; stem erect, stout, 2 to 3 feet; leaves numerous, palmately compound, large; flowers in large and showy terminal clusters.

This plant, unlike most other legumes, grows best on a soil containing but little lime, and so is especially valuable for the soils along the coast and for much of the pine-woods region. It affords good grazing, and the hay is valued as fully equal to that from red clover. The seed is high priced, and as from 75 to 100 pounds are required per acre the plant is not yet common, but is well worth planting experimentally on soils poor in lime. In Europe it is used successfully for renovating worn out sandy soils.

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BULLETIN No. 16. Agros. 32.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

GRAZING PROBLEMS IN THE SOUTHWEST

AND HOW TO MEET THEM.

BY

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PREPARED UNDER THE DIRECTION OF THE AGROSTOLOGIST.

1862 1889

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., January 25, 1899.

SIR: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 16 of this Division, a report on the grazing problems in the Southwest and how to meet them, by Jared G. Smith, assistant chief of this Division.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

The vast areas of grazing lands in the Southwest have long been justly famous, and the almost numberless herds of cattle and bands of horses raised and fattened upon the nutritious grasses of that region have enriched thousands of individuals and have been a source of great commercial wealth to the nation.

Less than thirty years ago 4,000,000 buffaloes and countless numbers of wild horses roamed unrestricted over the region in question, gradually moving northward as the season advanced, returning southward at the approach of winter. This natural movement of the stock permitted alternation of pasturing and rest for the land, resulting in the maintenance of the forage supply; in fact it was an ideal method of fostering and improving these pasture lands which covered nearly 200,000 square miles of country.

The nature and extent of the interests here, make this region an especially important one in the line of grass and forage plant investigation. The carrying capacity has diminished fully 40 per cent through overstocking and bad management during the past fifteen years, and the grazing and forage problems of the region demand serious and careful attention.

The Secretary of Agriculture, fully appreciating these conditions, directed this Division early in 1897 to begin investigations of these forage problems and conditions throughout the region of the Southwest, with instructions that particular attention be given to the native grasses and forage plants, their abundance and value, their preservation, and the possible methods to be employed in restoring the former carrying capacity of the ranges. The Division was also empowered to establish experiment stations for testing the grasses and forage plants in different sections of this region and to practice such methods of range renewal as might seem worthy of trial.

As a preliminary to these investigations a circular of inquiry was sent out to over 1,500 stockmen in Texas, New Mexico, etc. The replies, together with other correspondence which these circulars elicited, have brought together many valuable facts and demonstrated that the stockmen throughout the region in question are anxious that the work should be commenced and willing to cooperate with the Department in any way possible.

The assistant chief of the Division was sent to Texas about the middle of May, 1897, and between that time and the 1st of September collected botanical material and made extensive notes and observations on range conditions of central and southern Texas, visiting some 30 stations in that State and New Mexico, securing information by direct observation in about 50 counties, and getting a great many notes from stockmen in regard to the grasses and topography of the country and the natural conditions of sections which it was impossible to explore. The work was carried up the Pecos Valley as far as Roswell and to Deming and Silver City in western New Mexico.

Mr. H. L. Bentley, of Abilene, was given a commission to collect specimens, make notes and write a report on the past and present conditions of the grazing industry in central Texas. His report, applicable to the territory, 200 miles long and 150 miles wide, between the ninety-eighth meridian and the western edge of the Staked Plains, has been published by this Division, in Farmers' Bulletin No. 72 and Divisional Bulletin No. 10. Mr. Orrick Metcalfe was employed to collect seeds of the best of the range grasses in the vicinity of Silver City and along the valley of the Gila.

As a result of this work it was decided to obtain control of a body of overgrazed land in the Panhandle and another in central Texas in order to carry on experiments in methods of practical range improvement. After correspondence with a number of the leading stockmen Prof. C. C. Georgeson was sent in March, 1898, to inspect the sections offered for the use of this Division. He chose 640 acres near Channing, on the north plain, north of the Canadian River, and another 640 acres near Abilene, just south of the western arm of the western cross timber belt. Professor Georgeson organized and commenced experiments at Channing, but was unable to establish the work at Abilene because of a transfer to another line of work in the Department, and Mr. Smith was ordered to Abilene to superintend the matter during the latter part of March and first of April. In order to carry on the work as outlined Mr. H. L. Bentley, of Abilene, Tex., was given a commission as special agent in charge of the experiments at that point.

This work in range improvement is the first that has been tried either by the Government or by any State experiment station. The only experiment at all comparable was that begun some years ago at Garden City, Kans.

Some preliminary work had been done in the Southwest by this Division in 1896. In February of that year Mr. C. R. Orcutt, of San Diego, Cal., was given a commission for three months. He was instructed to proceed through Arizona and New Mexico as far east as El Paso, and to collect such specimens and make such general observations concerning the grasses and forage plants of the region as would be of interest to the Division. In September, 1896, the assistant chief of the Division was instructed to proceed to several points in Texas and New Mexico for the purpose of acquiring information concerning the grasses and forage plants of that region. In consequence of this trip we have been able to secure, through Mr. James K. Metcalfe, of Silver City, N. Mex., quantities of seeds of native grasses and forage plants, which have been used in the experimental work of the Division.

It will be of interest to many to note here the work previously done by the Department of Agriculture in the Southwest.

In 1886 Dr. George Vasey, in Bulletin No. 1 of the Division of Botany, drew attention to the enormous loss of cattle in the Southwest through overstocking of the ranges and lack of protection from storms in winter. In 1883–84 the Bureau of Animal Industry investigated the range problems with special reference to the loss of stock from storms. This loss was estimated to vary from 5 per cent in a mild winter in Texas to 18 or 20 per cent in the Dakotas and Montana. The next report which treated of the condition of affairs in Texas was Bulletin No. 3 of the Division of Botany, published in 1887, in which the attention of the general public was for the first time drawn to the value in cultivation of Colorado grass (*Panicum texanum*) and Texas blue grass (*Poa arachnifera*), and also to alfilaree, bur clover, Japan clover, mesquite bean, and prickly pear. In 1887 an expedition was conducted in western Texas by Mr. G. C. Nealley, and in New Mexico, Arizona, Nevada, and Utah by Prof. S. M. Tracy, who was at that time at the University of Missouri. Professor Tracy's report was largely botanical, while Mr. Nealley's was not only botanical, but contained many economic notes in regard to the grasses and such forage plants as "sotol," mesquite bean, and prickly pear. The reports of Messrs. Tracy and Nealley were published in Bulletin No. 6 of the Division of Botany. An enumeration of the grasses of Texas, with descriptions by Mr. L. H. Dewey, assistant botanist, was published in Vol. II of the Contributions to the National Herbarium in 1890.

In 1891 Dr. Vasey, accompanied by Mr. L. H. Dewey, made a trip along the line of the Southern Pacific Railroad in Texas, New Mexico, and Arizona, stopping en route to make botanical collections and secure notes. These, however, were never published. Considerable collecting was done in 1890–91 by G. C. Nealley, mainly in the territory along the line of the Mexican National, the International, and the Southern Pacific railroads. In 1891 Mr. F. V. Coville, Chief of the Division of Botany, and Frederick Funston investigated from a botanical standpoint the flora of southwestern Nevada and southeastern California, incidentally gathering notes concerning the forage value of many of the plants of that region.

Previous to 1888 there were a dozen or more expeditions through some parts of the Southwest, but the notes made were almost solely in regard to the botanical relationship of the different plants. We are indebted for much of our knowledge of the forage plants other than grasses to the work of Drs. Palmer and Havard, the latter having been stationed at different army posts in Texas and the Southwest for a number of years. Dr. Havard's most valuable contribution was published as "A report on the flora of southern and western Texas" in Vol. VIII of the Proceedings of the United States National Museum, 1885.

F. L.-S.

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GRAZING PROBLEMS IN THE SOUTHWEST AND HOW TO MEET THEM.

INTRODUCTION.

The plains and prairies of Texas have long been famed as grazing regions. There are few similar areas where the natural conditions at the time of first occupation were so favorable to the rapid development of the stock industry. The country lying between the Rio Grande and the thirty-fifth parallel of latitude and between the ninety-eighth and one hundred and fifth meridians is a succession of prairies and plains, rising gradually by successive broad steps from the coast to the tableland of the Staked Plains at an altitude of about 4,000 feet. This series of plains is broken by mountains only in the southern and southwestern portion and west of the Pecos River beyond their borders. Of the 190,000 square miles embraced in this territory probably not more than 10 per cent is adapted to successful agriculture under present methods, although one-fifth or one-third of it is capable of conversion into farm lands, and doubtless will be so converted at some future period, when the farmer is able to preserve the abundant natural resources of the region and profit thereby.

At the time of the earliest settlement this Texas territory was for the most part treeless, excepting along the streams and where the two bodies of "cross timbers" entered it on the north and where a wedge-shaped tongue of the east Texan timber belt penetrates the prairies south of Austin and San Antonio. The land was well covered with grasses, and was grazed by immense herds of buffalo, wild horses, and great numbers of deer and antelope.

Among stockmen the tendency has been to look upon these wild lands as never having been grazed until cattle and sheep were introduced, but there is abundant evidence to show that they have always been closely pastured. The early explorers differed in their accounts of the luxuriance of the grass vegetation, but the differences were no greater than can be accounted for by local or temporary causes, such as variable seasonal rainfall, which occur at the present day.

It is estimated that the southern buffalo herd contained not less than four million head.* This vast number grazed in the district south of the Platte River, retiring to the plains of western Texas and the Indian Territory at the approach of winter, and turning northward again in early spring. There were also numberless herds of wild horses, according to the narratives of some of the early explorers and hunters.

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* Smithson. Report National Museum, 1887. The Extermination of the American Bison, p. 498 and following. Hornaday.

There was a constant shifting of the wild herds in their search for the best pasturage, and with the season, drifting northward with the spring and southward at the approach of winter, congregating where there was water and grass. The conditions were entirely natural and the movements of the herds were almost unrestricted. The intermittent grazing and resting of the land resulting from the roving habits of the buffalo and mustangs was an ideal method of fostering and improving the natural pasturage. The result of this alternation of pastures, conducted on a gigantic scale, was that the native grasses were allowed to fully ripen their seeds, and perpetuate themselves each year in the most liberal manner. The best grazing grasses were developed by the processes of natural selection and survival of the fittest. Weeds and brush were kept in check by the annual fires set by the Indians in early spring to improve the pasturage for their ponies and the wild game. In this manner the encroachment of thorny shrubs, cactus, and mesquite was prevented, and each grew only where protected in the valleys along the streams or in scattered clumps at rare intervals in the open. The disappearance of the buffalo* was nearly coincident with that of the Indian,† and there was a period of fully ten years after the destruction of the buffalo herds before the number of cattle and sheep on any portion of the ranges equaled the great herds of game. These years, from 1874 to 1884, may be called the "golden period" of the Southwestern stockman, or at least a golden one for those whose flocks and herds were already on the ranges. During this intermediate decade there were fewer head of stock, wild or domestic, than at any previous period. There were also abundant rains and the seasons were mild and favorable to the full development of the grasses. Grasses and forage plants, ungrazed, grew and thrived, reseeded themselves, and increased to a wonderful degree of luxuriance, so that the stockmen on entering this pastoral paradise thought that it was not possible to put enough cattle and sheep on the land to eat down all of the rank growth of vegetation. It is the common testimony of the older stockmen that in the early eighties the grass was often as high as a cow's back, not only along the river bottoms, but also on the uplands far from the creeks and rivers.‡

FREE RANGES.

Before 1883 the ranges of central and western Texas were free to any man who chose to run stock upon them. The land was inaccessible from the railroads and was considered of no value for general farming purposes. In 1883 the Texas and Pacific Railroad was built through the heart of the range country, and there was an influx both of owners or agents of the lands and of investors who were seeking to acquire free ranges and free grass. Toward the close of this ten-years' shortage of stock there were undoubtedly sections where the native grasses would support 300 head of stock per square mile; and the average carrying capacity of the ranges as a whole was, so far as known, higher than at any time before or since. With the building of the railroad the stock industry underwent a very rapid development. Newcomers who had not seen the land when it was possessed by the Indian, the buffalo and mustang, at the time when the herbage was eaten down, or kept in check by fires or drought, naturally thought that this rich profusion of vegetation was the normal condition and that the saying that it was impossible to put enough cows on the land to eat all the grass was literally true. The result was a rapid and exhausting overstocking of every available square mile of range land. The best grasses were eaten down to their very roots, the roots were trampled into the earth, and every green thing was cut down so that it could neither ripen seed, and thus perpetuate its kind, nor recover from the trampling and exposure of its roots to the air and sun. The recuperative power of the grasses was lessened or destroyed, and weedy species which were present before, but which had been held in check by the luxuriance of the better, dominant sorts, immediately increased in number by rapid bounds. So also the mesquite bean and the cactus, both of which may be destroyed by fire, grew in numbers and commenced to crowd out the grasses.

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*The Southern buffalo herd was almost exterminated in 1873. Hornaday, l. c.

†The last Indian tribes were removed from Texas by act of Congress in 1874. Bancroft's Works, Vol. XVI, p. 25, 1889.

‡Farmers' Bul. No. 72, Cattle Ranges of the Southwest.

OVERSTOCKING THE RANGE.

There are many square miles of territory in the Southwest where the ruthless destruction of grass has been carried to the extent mentioned above. The grazing capacity of large bodies of land has been reduced within a period of twenty years from one head to 2 to 5 acres, to one head to 20 or 25 acres. As late as 1883 from 128 to 320 head of cattle could be supported on a single section, where to support a like number now requires from 4 to 12 square miles. Where the conditions have been especially unfavorable, stockmen report that it sometimes requires 60 acres per head, and the land there is almost bare of vegetation. Such denuded areas occur in New Mexico and Arizona, and are due almost entirely to the ruthless destruction of free grass on public lands.

The chief cause of overstocking in the first place was the free-range system, under which lands owned by the State, public institutions, or corporations, under the common law and in the absence of the owners or their agents, were considered as commons upon which any man was free to pasture all the cattle or sheep which he could command. The holding or use of lands in common always results in rapine, because of the principle that what is everyone's property is no one's, and no one is responsible for its abuse and spoliation. Because the legal owners of the land—in this case largely the State and public institutions and railroads—were not on hand to maintain their rights, they were ignored, and the result was then as it is now in most of the Western States and Territories containing unalienated Government land, that every blade of free grass was stripped from the soil. No thought was given to preserving the inheritance of those who were to occupy the land in future years; it was every man for himself, and he was the best man who could put the most cattle on the ranges to eat the most of the free grass. The natural outcome of this was that the ranges throughout the entire region were overstocked. Cow men thought that they could not put enough cattle on the ranges to eat all the free grass, and it was a very great surprise to most of them when in 1884 they began to discover the fallacy of this idea. The losses at that time throughout the whole Southwest were enormous, and the only thought of those who continued in the cattle business during the succeeding years was to recoup at all hazards and to follow the same tactics that had been previously employed—putting upon the pasture every head of stock which it was believed the land would sustain. As the strength of any structure is equal to the strength of its weakest part, so the carrying capacity of any large area may be considered equal to the number of stock which may be supported upon it during its poorest years. Just so sure as the number of grazing animals is allowed to increase beyond this conservative estimate there enters a greater liability to loss. For example, it is never safe to attempt to graze 75 or 80 head upon a section of land which will only safely carry 50 head the year round, although if the natural conditions are exceptionally favorable during a particular year a man may overstock his pastures and realize a profit during that year. On the contrary, should the natural conditions not prove to be as favorable as the stockman had hoped, his losses at 75 or 80 head per square mile will largely exceed the normal losses were the land stocked only to the extent of its minimum carrying capacity. Not only will the pecuniary loss, or the liability to such loss, be less and the actual profits on the cattle be more in the case of undergrazing, but the land itself will gradually increase in value and the grazing capacity will be augmented from year to year. In one case the land is stocked beyond its carrying capacity, so that it rapidly and continuously deteriorates in value; in the other case there is a constant increase in value both of the land and its products during the same series of years.

INVESTIGATION OF GRAZING PROBLEMS.

In the prosecution of an investigation of the Texas ranges a number of circular letters were sent by the chief of the division to cattle and sheep owners in the Southwest asking for estimates as to the percentage of increase or decrease of the carrying capacity of the ranges. An inquiry was also made as to what, in the opinion of stockmen, were the chief forage problems of this section; and advice was asked as to methods of restoring, renewing, and improving the ranges where they had been overgrazed. About 300 replies were received from stock and range owners in the State of Texas, and some of the data furnished are here tabulated:

County.	Number of persons reporting.	The present carrying capacity of the ranges; number of head per square mile.			Estimated percentage of increase or decrease in carrying capacity of the range in a period of twenty-five years.		
		Cattle.	Horses.	Sheep.	Decrease (per cent).	Neither decrease nor increase.	Increase (per cent).
Aransas	1	80	50		40		
Archer	3	40		300 to 700	38		
Armstrong	1	35					
Atascosa	1	53	40		25		
Bexar	5	66	50		40	(*a*)	
Brazoria—							
Average	7	96	90		40	(*a*)	
Salt grass	1	128					
Prairie	2	130					
Wooded bottoms	2	32				(*a*)	
Brewster	1	45					
Brown	1	40			8		
Burnet	1					(*a*)	
Castro	2	45	40		25	(*a*)	
Calhoun	1	213					
Callahan	2	60	35	300	*b* 40		
Camp	1	10			*b* 90		
Carson	2	65					
Childress	4	58	45		35	(*a*)	
Clay (average)	10	84			25		
Coke	1	50	30			(*a*)	
Collin	2	150		1,000	10		
Collin	1	*c* 250			33		
Coleman	3	70		300		(*a*)	(*d*)
Collingsworth	1	64	40			(*a*)	
Colorado	1	75			50		
Comal	1	60	30	200	50		
Comanche	1	60	40		50		
Concho	1	50			*e* 5 to 17		
Cooke	3	80	20	100	38		
Crockett	1	25	20	100			(*d*)
Crosby	1	40	30	100	38		
Dallas (average)	4	77	85	210	27	(*a*)	
Deaf Smith	3	32					20 to 25
Denton	1	83			33		
Dewitt	4	97	85	600	29	(*a*)	
Dickens	1	45			29		
Donley	5	52	50	256	38	(*a*)	(*d*)
Duval	1	64			33		
Eastland	1	68					
Ector	2	25	20	100		(*a*)	
El Paso	1	16			25		
Erath	2	62		200 to 640	50		
Fisher	3	47	35		50	(*a*)	
Foard	10	51	64	150	26	(*a*)	33 to 50
Gallagher	1	40	10		40		
Galveston	1	200				(*a*)	
Goliad	1	70				(*a*)	
Gray	1	50				(*a*)	
Grayson	1	210				(*a*)	
Hale	1	32					
Hall	3	52				(*a*)	(*d*)
Hansford	3	40	10		29	(*a*)	
Hardeman	1	45	11				(*d*)
Hartley	1	64	64	160		(*a*)	
Hemphill	5	34	28		12	(*a*)	(*d*)
Hopkins	4	83	75	200	50		
Hood					50		
Howard	3	32	30	200		(*a*)	
Hutchinson	1				33		
Irion	2	52	40	120 to 200	33		(*d*)
Jack	2	64			50		
Johnson	1	200					
Jones	1	5			33		

a No decrease except through occasional bad seasons.
b Decrease from brush.
c March to November.
d Marked improvement.
e In twenty years.

County.	Number of persons reporting.	The present carrying capacity of the ranges; number of head per square mile.			Estimated percentage of increase or decrease in carrying capacity of the range in a period of twenty-five years.		
		Cattle.	Horses.	Sheep.	Decrease (per cent).	Neither decrease nor increase.	Increase (per cent).
Karnes	1	100	58	220	75		
King	1	45			30		
Knox	2	52	40		38		
Lasalle	1	60	50	640	50		
Lipscomb	4	40	25		50		(*a*)
Live Oak	1	80	60	640	*b* 25		
Lubbock	2	32	25	250	38		
Lynn	2	40	32		*c* 50		
Matagorda	2	132	80	500	38		
Maverick	1	33	24	170	40		
McLennan	1	100				(*d*)	
McMullen	2	70	45	420	23		
Midland	7	30	24	104	*c* 33	(*d*)	(*a*)
Menard	1						(*a*)
Mitchell	5	53	40	150			(*a*)
Montague	5	68	60	225	45		
Moore	2	50			33		
Nolan	4	48	30	300	40	(*d*)	
Nueces	5	74	60	850	*b* 35		
Ochiltree	1	57			80		
Oldham	1	35			33		
Palo Pinto	3	80	75	1,200	38		40
Parker	1	100	50			(*d*)	
Potter	10	32	30	200	25		
Presidio	1	30	30	60		(*d*)	
Rains	3	57	62	150	65		
Randall	1	64				(*d*)	
Roberts	5	34	20		33		
Runnels	2	75	50	300	18		
San Augustine	1	83			20		
San Patricio	3	56	40		*b* 50		
San Saba	2	65	30	120	28		
Scurry	2	38	25		25		
Shackelford	6	64	55	250		(*d*)	
Sherman	1	60				(*d*)	
Starr	1	35			66		
Sterling	3	45	32		83		(*a*)
Stephens	4	64	45	450	31		
Tarrant	5	96	80	620		(*d*)	
Taylor	1	64	60		10		
Throckmorton	1	32			30		
Titus	3	20			70		
Tom Green	12	53	39	210	33	(*d*)	(*a*)
Uvalde	1	60	30	250	50		
Valverde	2	50		150	33	(*d*)	
Victoria	4	122				(*d*)	(*a*)
Waller	1	210					
Ward	5	17	17	120	50		
Wheeler	2	35	30		38		
Wichita	3	66			24		
Wilbarger	9	44	32	112	28		
Williamson	3	48	25	100	40		
Wise	1	100			30		
Wood	3	90			80		
Young	12	60	35		42		
Zavalla	1	55	28				100

Number of counties	115
Number of stockmen reporting cattle	302
Average carrying capacity, cattle, per square mile	64.8
Number of stockmen reporting horses	67
Average carrying capacity, horses, per square mile	33
Number of counties where carrying capacity has decreased	82
Average percentage of decrease	40
Number of counties reporting improvement in pastoral conditions	19

a Marked improvement.
b Decrease from brush.
c Decrease from prairie dogs.
d No decrease except through occasional bad seasons.

According to the above data it will be seen that the average grazing capacity of the State as a whole, as reported by 302 stockmen, in 115 counties, is a trifle over 64 head per square mile, or 1 head to 10 acres.

The estimated average decrease in the carrying capacity amounts to 40 per cent in 82 counties, while in 19 counties a marked improvement in the pasturage within recent years is reported. Accepting this estimate of a 40 per cent average decrease, the grazing capacity in former years must have averaged at least 106 head of stock cattle to the square mile. This loss, in the central and western portions of the State, is almost entirely due to the ravages of prairie dogs and to putting too many cattle on the land. Farther south the encroachment of brush and cactus and a large increase in the number of jack rabbits are additional causes. The pecuniary loss which the stock owners of the State have sustained since 1883 is not the only evil arising from grazing too many cattle on the land. Overstocking not only causes loss of cattle and sheep from starvation in time of drought, but it causes the rapid extermination of the most valuable of the native grasses and forage plants. In any pasture the grasses which are first eaten down are those which are most nutritious or most palatable. Unless the pasturage is fostered and these best grasses are protected by resting or by artificial care and cultivation, they are soon reduced in number and become unimportant factors. They are prevented from ripening seed and are eaten so close that often the roots are killed by exposure. The first result of overgrazing is the disappearance of the best grasses, that is, a lessening of the potential carrying capacity of the pasture. If the best grasses cover 25 per cent of the range, the loss from overgrazing will be at least that amount. If the pasture is still overstocked, a similar process is continued with the remaining species until at last there is not a blade or fragment of a stem left to support any grazing animal. The young shoots are eaten off as rapidly as put forth by the plant and the vitality of the plant is sapped, so that it is unable to endure extremes of temperature or shortage of water supply to the same degree as when its growth has been uninterrupted. It has been noted that very often in times of drought the best grazing grasses, such as sedge grasses, needle grasses, gramas, and curly mesquite, which will ordinarily withstand the hardest usage, are destroyed root and branch by being eaten into the ground. Not only is the grass destroyed, but the ground over extensive areas is trampled and compacted by the cattle until every sprig that grows upon it breaks up and is blown away. Following the destruction of the valuable perennials, the low annuals, such as the six weeks' grama, come in and supply almost the only feed. At the same time that the valuable grasses are disappearing the land is being invaded by a vast number of rampant weeds which are not eaten by any grazing animal.

It is the opinion of a majority of stockmen who replied to the question as to the amount of range deterioration, that there has been a very large loss in what may be called the capital value of the grazing lands within a very short period. The land which is made poor by this stripping process suffers actual decrease in fertility through exposure of the surface layers to the sun and air. Soils which are covered with verdure are always fertile and those which lack a protecting plant covering are sterile and deficient in "life." Overgrazing also subjects the soil to the destructive action of torrential rains. When rain falls upon any field thickly covered with grass or other vegetation, the surface drainage is much retarded because the total surface for the retention of water is largely increased; but when the grass is eaten off, or destroyed in any other way, not only is less of the rainfall absorbed but the full force of the rushing waters is exerted upon the exposed surface, and vast quantities of the finest and richest parts of the soil covering are washed into the streams. This denudation of land by the destruction of its grasses, while perhaps not so familiar as that following from the destruction of forests, nevertheless is proceeding quite rapidly in a great number of places in the West. The washing away of the soil proceeds less rapidly on the plains where the slopes are less abrupt than in the mountains, but the result is just as sure, although the obvious destruction is less marked. Wherever grasses are allowed to fully mature and are not entirely eaten down, there is a decided difference in the amount and rapidity of the drainage. Less water runs off into the streams in the form of floods and more is absorbed into the soil. These are the various results of the evil course of overstocking the grazing lands of the West, which if persisted in will surely supply another example of the transformation by human agencies of a fertile land into a desert waste.

DESTRUCTION OF GRASSES BY ANIMAL PESTS.

In addition to the destruction of the grasses by stock, the number of grass-eating pests, especially prairie dogs and jack rabbits, has rapidly increased. These were formerly kept in check to a large extent by their natural enemies, but when the bulk of the gray wolves and coyotes were killed off by the stockmen, on account of their depredations among sheep and young cattle, there was nothing to prevent the grass destroyers from rapidly increasing and spreading out over new territory. Another potent cause of the spread of these pests to new land is the destruction of the grass and the consequent diminution of their natural food supply. There are now hundreds of square miles of prairie-dog towns in the central and western portion of the range country, while in the South the jack rabbits are becoming very numerous. Five jack rabbits will consume enough grass per annum to keep one sheep, and twenty prairie dogs will eat and spoil even more. Like the rabbits in Australia, both of these pests breed rapidly, so that it takes only a short time after the decimation of either one by epidemics or by poisoning to fully recruit their numbers. Poisoning can be made effective if there is concert of action among the stockmen in any given locality. The dogs and rabbits must be killed in all the pastures within a district. To destroy them in one pasture or township and not in the adjoining ones amounts to throwing away time and money. There is great need of systematic effort to check the increase of both rabbits and prairie dogs. The amount of forage annually destroyed by them is enormous. The loss of grass is distributed among a large number of stockmen, and so is not felt in its entirety by individual owners, but the loss in taxable values to the counties and the State is no small one. The grass eaten by 100,000 rabbits would support 20,000 sheep, and there are many counties in southern Texas where this would be a very moderate estimate of their numbers. In the heart of the prairie dog-infested region the writer has seen extensive villages where, at a very conservative estimate, there were from 2,000 to 5,000 prairie dogs to the square mile. Now, on a square mile of land so infested the dogs eat and defile grass enough to maintain from 100 to 250 sheep per annum. Prairie dogs will not tolerate tall grass near their burrows, probably partly on account of the cover thus given to their enemies, and partly because these grasses are better relished by the dogs. They dig up the roots of all of the more succulent species, like the sedge grasses, and permit only the low turf formers to remain. The dog-village grasses are needle grass, curly mesquite, woolly oats (*Triodia avenacea*), and, in western Texas and New Mexico, hard grass (*Scleropogon brevifolius*), a harsh-stemmed turf-former seldom found in abundance anywhere else. Some of the grasses that occupy the prairie dog-infested land are intrinsically valuable for grazing, especially in winter when cured on the ground, but they lack the bulk of the taller kinds which would grow on the land if the prairie dogs were killed. Lands occupied entirely by these grasses are not and can not be called productive; they have reached almost the lowest stage of deterioration, and are next to valueless for grazing purposes. The extermination of prairie dogs and jack rabbits means a great deal if the grazing industry is to be developed to its fullest extent.

DETERIORATION THROUGH INCREASE OF WEEDS.

Another factor which is tending to decrease the carrying capacity of the ranges, as a whole, is the rapid spread of prickly pear and thorny shrubs in the South and of the mesquite bean on the table lands and higher prairies. At certain times or in certain seasons both the prickly pear and the mesquite bean are of some value as sources of food, but their increase can not be looked upon as wholly beneficial.

PRICKLY PEAR.

The flat joints of the prickly pear (*Opuntia engelmanni*) are mucilaginous and watery, and in times of drought serve to some extent as food, or, more especially, water. Cattle and sheep may be kept alive for several months on prickly pear when all other forage has become dried and broken and has blown away—a state of affairs that often occurs during a severe drought. At such times, if the stockman has put his trust entirely in the native herbage and the natural water supply and has made no provision for bad seasons by putting up hay or by digging wells or making storm water tanks, the prickly pear may be considered a valuable forage plant, as without it the stockman could not bring his cattle through the drought alive. But in the good years—and there are a great many more good years than bad ones—the prickly pear takes up space that might be better filled by grasses, for when there is plenty of grass, cattle do not touch the cactus, and its rank growth shades and chokes out the better forage. In the lower valleys, from the Guadalupe River west, this cactus forms thickets with the various spiny shrubs that compose the "chaparral"—tangled copses with paths winding here and there among clumps that are each year becoming more impenetrable. The only grasses that thrive here are shade-loving species, which, compared with those that grow in the full sunlight, are unpalatable and of little feeding value. A few sprawling stems of some of the better and formerly abundant grasses struggle upward toward the light wherever protected from extermination by the sharp-spined cactus, but it may no longer be called a well-grassed country. From the standpoint of the botanist the prickly-pear thickets are splendid collecting grounds, but from the standpoint of the ranchmen the increase of cactus, rapid in good years and slow in bad ones, is extremely prejudicial and withal disheartening. Scarcity of rainfall does not seem to influence the prickly pear the same way as the grasses, the former simply holding its own during times of scarcity and shooting ahead with renewed vigor when the rainfall becomes normal, the latter quickly dying to the ground. On the southern prairies the stockmen have seen the change within fifteen or twenty years from open country, covered knee-high with luxuriant grasses, to a tangled thicket with grasses only at intervals, and the prickly pear so thick that it is hard to drive cattle through it.

How to destroy prickly pear.—Fire is the only remedy which is always effective in fighting the prickly pear, but to develop enough grass and undergrowth so that a fire will run through thickets composed of this cactus requires that cattle shall be kept out of the pastures one and often two years, and few stockmen are willing to sacrifice two years' growth of grass even to rid themselves of the prickly pear. Mr. William Benton, of Nueces County, estimates the loss of pasturage from encroachments of prickly pear within the last ten years at from 25 to 35 per cent, year in and year out, and the present outlook is worse rather than better. In other words, lands which have not suffered to any appreciable extent in actual fertility, or in what may be called the potential fertility of the soil constituents, have only the capacity of producing from two-thirds to three-fourths as much forage now as ten years ago, although they are at present covered with a far greater bulk and amount of vegetation. Many stockmen who have noted the progress of this pest are of the opinion that in another twenty years prickly pear will cover a large part of the now open or fairly open grazing lands in the southern part of Texas, to the detriment of all stock and land owners. As to the cost of destroying prickly pear by means of fire, take, as an example, 1 square mile of land which will carry 64 head of stock cattle the year round without winter feeding. It requires three years to mature a steer, so that the grass product of the square mile for one year will be equivalent to the amount of forage necessary to fully mature 21 head. It has been estimated that a cow or growing steer of 1,000 pounds live weight requires per day in pasture about 110 pounds of green grass, containing from 24 to 27 pounds of digestible food. At 110 pounds per day this would amount to 20.07 tons of green grass per head of stock per year. Hence a pasture that carries 1 head to 10 acres must produce at the rate of 2 tons of green grass per acre. Taking $20 as a fair average valuation for the cattle, the market value of the grass turned into beef would be 21 times $20 or $420, per square mile per annum, or about 66 cents per acre. Sixty-six cents per acre would, according to the factors assumed, be the money loss in grass if the pasture were burned after a lapse of one year. It is doubtful whether any other method anywhere near as cheap could be used to destroy the prickly pear. To be the most effective the pasture should be burned in spring just after the new growth has commenced, because the cactus is then most easily destroyed. The young and tender shoots would be scorched and cooked and prevented from further development, and the singeing off of the spines on the older shoots would expose them to destruction by animals. The fire would also check the development of the weeds and brush that thrive in the shelter of the clumps of cactus. If hogs or goats could be herded on the prickly pear after the fire, the destruction would be much more complete. Goats especially are good scavengers to clean up weeds and all kinds of noxious rubbish.

The following statements serve to illustrate the change that has taken place in southwestern Texas through the increased growth of prickly pear. Bartlett* says:

> About the parallel of 29° 30′ the table-land breaks off into numerous spurs, descending to the great plains or prairies, which extend in a broad belt from 150 to 200 miles in width. The whole of this district consists of gently undulating plains, *without timber save along the margins of the streams,* and is covered with the most luxuriant grass. The indigenous prairie grass is tall, coarse, full of seed at the top, and when young resembles wheat in the spring. But in grasses the glory of the State is the mesquit, found only in western Texas. It yields a fine soft sward, preserves its verdure in the winter, and beyond all comparison affords the best wild pasture in the world.

Now this same region is covered with brush and cactus. Again' describing the country between the Rio Grande and Corpus Christi, Bartlett says that the chaparral only occupied the immediate Rio Grande Valley, a strip 6 to 8 miles wide, and that beyond this to the northward there was a rolling prairie with a few scattered bodies of cactus and low mesquite trees.

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* Bartlett, Personal Narrative, 1854, Vol. II, p. 566.

THE MESQUITE BEAN.

The mesquite bean (*Prosopis juliflora*) has a very wide natural distribution from Texas to Argentina. It is one of the characteristic trees of the lower Sonoran zone, an area where the conditions as to rainfall and climate range from arid to semiarid—that is, the rainfall varies from less than 10 to about 25 inches per annum. With the exception of the coastal plain immediately bordering the Gulf, all of the best grazing lands lie within this zone. In habit of growth the mesquite bean resembles a peach tree with rather scattering foliage. It normally produces from one to three crops of beans every year. The pods are filled with a sweetish pulp, which causes them to be much sought after when ripe by cattle and horses, and stockmen consider them as fattening as grain. The production of pods is governed largely by the season. In a year when the rains are uniformly distributed through the growing season the yield will be light.

Stockmen say that if there is a spring drought followed by abundant summer rains, and then again an autumn drought, the mesquite trees will either make two crops of ripe beans or will shed the first crop before fully ripe and throw out a second lot of flowers in midsummer. This, of course, depends on the stage of growth which the beans have attained when the midsummer rains come. The beans are produced in greatest abundance during the dry years, and are then very valuable forage. The sweet pods are greedily eaten by cattle, and prove almost as fattening as barley or other grain. The yield varies from a few bushels to often 75 or 100 bushels of ripe pods from the trees on an acre of land. The seeds are hard and indigestible, and remain in the dung when the pods are eaten by cattle. They then seem to be even more sure of germination than when the pod is left to rot on the ground. By this means alone this tree is spreading rapidly each year over new territory, the seeds being scattered far and wide by all classes of animals that feed on the pods. In the early days, when the central prairies were sparsely settled, they were burned over each year, and the young seedlings of this and other trees were killed to the ground. Twenty years ago it was hard to find a mesquite bean on the open prairies that was larger than a small shrub. The only places where they occurred of any size were in the valleys and the "timber islands"—small scattered groves at intervals on the prairies, usually about some swale or along a ravine or a rocky knoll. Since the more complete settlement of the country, fires are not allowed to sweep the prairies, on account of the possible loss of crops and improvements. There is nothing to check the growth of the mesquite bean, and they have grown to the size of small trees, at the same time largely augmenting in number.

A mesquite grove has two distinct advantages, viewed from the standpoint of the stockman. It supplies cover during "northers" and severe winter storms, and it produces varying crops of nutritious beans, often at the time of the greatest scarcity of other feed. On the other hand, there are several disadvantages. These mesquite groves are centers of infection for the range in that they form natural covers for the protection of prickly pear, cat's claw, wild currant (*Berberis*) and other spiny shrubs and noxious weeds. They tend to choke out, by overshadowing, the best and most nutritious sun-loving grasses. Furthermore, the trunks and branches cover quite an area of land on every section, so that it is a question whether the grasses which are displaced during nine good years would not be worth as much or more than the crop of beans during the tenth dry year.

The best grasses are those that grow in the bright sunshine. There is among grasses something of the same adaptation to locality, though perhaps not so marked, as among plants of other natural families. Some grasses—like the gramas, needle grasses, and blue stems—mature only in the bright sunlight, clear and unobstructed; others thrive only in half shade where protected by shrubbery and undergrowth, and others still would be burned out by the direct sunlight in a single day. The feeding value of the grasses also varies directly according to the amount of sunlight which they receive during the growing season, and the grasses that live in the full sunlight are far more nutritious, will fatten an animal sooner, and cause more rapid gain in weight than those which grow either in the woods or in half shade. Viewed from this standpoint, the rapid encroachment of the mesquite bean on the open range must in time be detrimental to the carrying capacity of the range. The consideration of these points must enter into the problem of range deterioration and improvement. The wild grasses of the high prairies and table-lands depend upon the flood of sunlight for their high feeding value. If that is cut off or the light rays are interrupted by the foliage of trees, the inherent fattening qualities of the grasses are lessened. In this way both the individual cattle owner and the State will suffer. The individual losses may seem very small and unimportant, but in their aggregate they amount to no inconsiderable sum, which must be subtracted from the total working capital of the State.

RENEWING THE CATTLE RANGES.

That the natural pastures are in need of practical and scientific treatment in order to increase their grazing capacity no one who is acquainted with their past and present condition will deny. The most obvious methods of bringing about the desired improvement are either resting for several seasons to enable the grasses to retake the land which has been denuded of its most valuable grasses, or cultivating the surface of the pasture in order to accelerate the gradual natural processes.

Besides these, there is need of finding out what can be done in the way of cultivating the best native grasses, of increasing the number of valuable sorts by introduction of foreign species, of determining whether a stand of certain forage plants may be secured by sowing the seeds on the unbroken sod or on land which had simply been harrowed, and of determining the practicability of inoculating range land with turf-forming grasses.

For the purpose of carrying on such experiments two sections of land have been leased by this Department, one at Channing, in Hartley County, Tex., which will represent, in a large measure, the conditions that prevail in the high plains of the Panhandle, and one at Abilene, Tex., to serve for the central and western prairies up to the border of the Staked Plains. On each of these sections three 80-acre and two 40-acre pastures have been fenced and are being treated as follows:

Pasture No. 1.—No treatment except to keep stock off until June 1, pasturing the balance of the season.

Pasture No. 2.—Cut with a disk harrow and keep stock off until June 1, pasturing the balance of the season.

Pasture No. 5.—No treatment except pasturing until June 1, and keeping stock off the balance of the season.

Nos. 1, 2, and 5 each contain 80 acres. Pastures numbered 3 and 4, each consisting of 40 acres, are being grazed alternately, the stock being changed from one pasture to the other every two weeks. In addition to these fenced and stocked pastures, 80 acres of land were dragged with an ordinary straight-toothed iron harrow, one 80-acre tract was disked, and a third was left as a check without any treatment whatever except that, in common with the other two, no stock was allowed to run on it during the first season. The remaining 80 acres are devoted in part to the cultivation of grasses and forage plants, using both such as can be obtained in the markets, and the native sorts, while a portion has been set apart for minor experiments. Among the latter may be mentioned the breaking of east and west furrows at intervals in order to intercept and catch the seed of the needle grasses and other bearded seeds which are blown over the ground by the prevailing north and south winds; the sowing of seeds of various wild and cultivated forage plants directly upon the sod without other treatment, and experiments in transplanting the best of the wild turf-forming grasses to bare spots by setting bits of turf in the ground with a spud or simply pressing them with the boot heel into the soft earth after rain. On some portions of this 80-acre field, experiments will be made in sowing alfilaree, bur clover, Bokhara clover, and valuable wild forage plants which grow in other similar regions directly on the sod without further treatment than to keep stock off during at least the first year. The section at Abilene was inspected before the commencement of the work by a committee of stockmen who made an estimate of the carrying capacity of the land at that time. It will be judged at intervals throughout the experiments by the same committee in order to determine as exactly as possible the rate and percentage of improvement in the different pastures under the different methods of treatment. These experiments will be carried on for three years, at the end of which time sufficiently definate results ought to be secured to enable the stockmen to decide what is the most practical method of bringing back the grasses. On the cultivated land a large number of species will be tested in regard to their adaptability to semiarid conditions. Not only will the seedsman's lists of grasses and forage plants be drawn upon, but a special effort will be made to cultivate such native plants as tallow weed, Metcalfe bean, Texas pea, and Buffalo pea. From the results thus far secured at the close of the first season's work, it would appear that the land which has been disked is improving at the most rapid rate. Even at the rate of 40 cents per acre, which was paid for the work, this treatment costs fully one-third less than simply resting the land without treatment, and more than enough grass can be secured from the disked land the first year to pay for the cost of the labor.

The best results have accrued from loosening the surface of the ground in early spring before the grasses commence their new growth. It stimulates the roots of such grasses as are already established, causing them to grow with renewed vigor. At Abilene at the close of the season (October 15, 1898) it was estimated that the grasses on land which had been disked in the early spring had improved at least 25 per cent in carrying capacity—that is, there was 25 per cent more grass on the land at the end of the first season than appeared on adjoining pastures which were not treated in any way. Both pastures were grazed with the same amount of stock and treated as far as possible alike. The experiments here referred to were commenced in the spring of 1898.

REST VERSUS ALTERNATION OF PASTURES.

A great many of the stockmen who have reported concerning the state of their ranges have suggested that the resting of the land would be the cheapest and most practicable method of again bringing it up to its highest value. Resting is an excellent treatment wherever sufficient grass remains to reseed the land. It is, however, not the most rapid method, nor can it be considered the cheapest when one takes into consideration the fact that the land to become fully regrassed must be rested sometimes three or four years. Complete resting of a pasture is really a more expensive means of improving the pasturage than many would suppose. As shown above, in the case of range deterioration through the growth of cactus, the grass on an acre of land on a section capable of carrying 64 head of stock cattle is worth 66 cents per acre when the cattle are appraised at a valuation of $20 each. At this rate the cost of the renewal of the pasture in the course of a few years would amount to very nearly the value of the land.

Partial resting, or resting during different seasons of the year, a system which may be designated the alternation of pastures, secures the same result at much less expense. Thus a range might be divided up into a number of small pastures provided with water, in each of which the cattle would be allowed to run for not more than two or three months at a time and then be transferred to another. In this way the succession of grasses which normally occurs in nature can be fostered and improved. Let us suppose a range of 100,000 acres in extent divided into ten pastures of 10,000 acres each. At the average carrying capacity for the State this body of land will produce forage enough to sustain 10,000 stock cattle throughout the year. These divided up into their various classes—beef steers, two-year olds, and yearlings, cows and calves—could be held three months in one pasture and then transferred to another which had been kept free from stock during that ength of time. A rest of two or three months during the growing season in early spring would enable the early grasses to ripen and shed their seeds, thus perpetuating the early species. After the seed had fallen, the cattle could be turned on the grass for two or three months and again transferred to a fresh pasture. In the same way autumn and winter pastures can be secured. Several stockmen who have employed this method on a large scale for a number of years say that their ranges are continually improving, in marked contrast to the deterioration that had occurred through bad treatment of neighboring properties where the old methods were practiced. It is also claimed that pasture land thus treated will carry more head of cattle through the year and bring them out in better condition than where the herd has access at all seasons of the year to all portions of the range. Where winter feeding is practiced in connection with alternation of pastures, the very best results may be obtained at the least cost, and the owner will find that with judicious care the value of his property will constantly increase and the annual profit as represented by the increased number of marketable steers will more than compensate for the cost and labor of changing cattle from one pasture to another.

ADDITIONAL AIDS TO RANGE IMPROVEMENT.

In addition to the methods of improving the range by cultivating the surface of the ground, raising native grasses, plowing occasional furrows to arrest the wind-borne seeds, and scattering the seeds of native and introduced forage plants on the unbroken sod, the cultivation of the ranker and bulkier forage crops should be encouraged. On almost every ranch there are strips of valley lands, or often extensive meadows, which are naturally well watered, or which are so situated that they may be irrigated from artificial tanks. These lands should be put into cultivation. The rancher is often loath to incur the expense and trouble necessary to grow and cure a patch of sorghum or of some hay grass, but the possession of a sufficient amount of cured fodder or hay will insure him against excessive loss as the result of drought or of the rotting of the natural pasture grasses through autumnal or winter rains.

STACK SILAGE.

The practice of making good hay from alfalfa, cowpeas, Johnson grass, the sorghums, and other coarse or succulent plants is often attended with much difficulty, and the product varies in quality and value according to treatment. Successful hay making requires considerable experience, besides taking time and a large force of laborers, so that the expense of preparing a cured crop often amounts to very nearly its feeding value. The fact that it requires a number of men will sometimes prevent cattle owners from trying to put up any hay. The desirability of having a quantity of green, or at least succulent, feed during times of drought and during late winter and early spring months is well recognized. In the farming districts that want may be supplied by the cultivation of soiling crops, root crops, and by putting up silage, the latter prepared in strongly built silos. The cost of building a silo precludes its use by the majority of farmers and stock owners, especially in the more sparsely settled districts and in the arid and semiarid portions of the Southwest, where lumber and labor are high priced. Fodder and hay are very desirable, but they must be cheap and easily prepared else they will not be used. Stack silage or open-air silage is extensively used in portions of Australia, South Africa, and northwest India, where the general conditions as to fertility of the soil, rainfall, and climate are about the same as in Texas and the Southwest.

It is claimed that the value of stack silage was first discovered about 1867, when a New Zealand farmer whose haying operations were interrupted by heavy rains, raked the green, freshly cut grass into a great pile, his idea being to save the, as he supposed, rotten mass for fertilizing purposes during the coming season. Instead of the grass rotting a fermentation took place and the product was eaten greedily by stock which were turned into the field during the winter. Whatever may be the source of the practice, the fact remains that stack silage finds a very wide use in hot countries among stock farmers and men whose means do not permit them to purchase silage cutters and build silos.

The theory of making silage is to pack the green forage into a compact mass, thus preventing the entrance of air into the material. The green mass undergoes a sufficient fermentation to partially cook and preserve it. In building a silo the walls are constructed of heavy timbers, braced and covered both inside and out with sheathing, tar paper, and matched boards, made as nearly as possible air-tight, for it has been found that wherever air penetrates into the mass or the fermentation is carried too far the silage becomes moldy, producing an indigestible mass. Where air has free access during fermentation, the process will be carried too far, but where the amount of air is limited the fermentation is only carried to a certain point and the palatability of the food is improved. It has been found that a silo and fodder-cutting machines to chaff the stems into small pieces are entirely unnecessary in dry climates. Instead, the green grass or green fodder is raked and stacked as soon as cut. Then, when the pile has been carried up as high as convenient, weights are put on the top and the sides are trimmed down perpendicular with a hay knife. This method produces a sweet silage, which has very nearly the same feeding value as silage prepared at greater cost in built silos.

Mr. Fred Koehler, of Bee County, Tex., has used stack silage made of sorghum, and considers it, when fed in connection with cotton-seed meal and hulls, the cheapest and best fattening material for topping off beef steers for the market. He builds a sort of paling fence, using 4- or 6-inch fence boards in 10 to 16 feet lengths, woven together with heavy galvanized fencing wire, leaving about a 2-inch space between the boards. The length of this fence can be accommodated to the diameter of the stack which it is desired to make. When the sorghum is ready to cut, which is about the time that the seeds are commencing to harden, one of these paling fences is set up in a circle, varying from 12 to 20 feet or more in diameter. Then using horse rakes, loaders, and stackers, the freshly cut or slightly wilted sorghum is fed over the tops of the boards into this pen, and the process is continued until the pen is filled. During the filling, the fodder is stamped down around the edges so as to leave no air spaces. When the pen is filled to the top a layer of straw is added and built up to a peak to shed rain. On this is piled dirt or stones or bags of earth to the depth of 2 or 3 feet, in order that the pressure shall range from 125 to 200 pounds to the square foot. Pressure may also be applied by means of a Spanish windlass or by levers. The palings remain in place until the stack has settled and compacted sufficiently to stand alone, when they may be removed and set up elsewhere and the process repeated.

It has been found that by applying the pressure at the right time one may readily control the fermentation and produce either sour or sweet silage as desired. Thus, if the fermentation is not allowed to proceed above 130° F., if the stacks are weighted when this temperature is reached sour silage is produced. If the fermentation is allowed to go on until the temperature rises to between 150° and 165° F. before the stacks are weighted, the mass will often become highly carbonized, appearing dark brown, or almost as black as charcoal, but the silage is sweet and relished by cattle. Sour silage is considered more satisfactory for dairy purposes than sweet silage.

The possibility of preserving large quantities of the coarser forage-plants by this method will undoubtedly prove valuable for extensive districts in the arid grazing regions. It will not, however, be adapt-able to humid climates. Wherever the rainfall amounts to more than 25 or 30 inches, or where the air is moist through a large part of the year, silos will have to be built. The manufacture of stack silage opens great possibilities and will enable stockmen to increase the number of cattle upon the range. If palings are not available for confining the silage and making the sides perpendicular, the stack may be built up in the same way as a haystack. At the close of the operation, after the forage is well settled and compacted, the looser outside portions may be trimmed off perpendicular with a hay knife and piled on top of the stack as a thatch.

Corn can not be depended on as a forage plant in semiarid regions. The best crops, and those which seldom fail, are sorghum, milo maize, Kafir corn, and Johnson grass, the latter for the richer bottom lands. Of the first three forage crops, from 10 to 20 tons of the green forage may be secured per acre, and at least two cuttings, from 4 to 8 tons each, of the Johnson grass. Two crops of sorghum may often be grown on the same land in one season. Fodder made from the sorghums is rather difficult to cure, or, to speak more properly, is difficult to handle after curing, on account of its bulk and the harshness of the leaves and stalks. Moreover, in the dry climate of the Southwest much of the best part of the fodder and leaves is lost in the process of handling, because becoming so dry and brittle. The stalks are also tougher than cornstalks, and there is more waste in feeding.

In the case of Johnson grass there are grave objections to its use for hay on a large scale, because of its weedy character when introduced into farm lands. The territory where Johnson grass is the most valuable hay grass, comprises the red prairie region, which includes the headwaters of the principal streams that in their lower courses flow through the rich farming lands of eastern and southern Texas. The seeds of this grass are liable to be washed down from the headwaters in time of flood, inoculating new fields with this, to the cotton farmer, undesirable pest. If the Johnson grass is turned into stack silage instead of being made into hay, the danger of spreading a bad weed will be obviated, because the germinating power of whatever seeds may be in the stack will be destroyed by the heat generated in the course of fermentation.

The principle of stack silage is not by any means a new one. The methods of curing clover and alfalfa in cocks are practically the same, as are also those of curing green corn and sorghum in shocks. In such cases fermentation of the partially wilted substance takes place, the difference being that the fodder in shocks ferments at a much lower temperature than in stacks. Thus silage can be made at very much less expense than hay. Enough has been done by stockmen and feeders to show that stack silage is not an experiment, but is entirely practical. It is probable that much may be added to our knowledge, especially in regard to such details as the best height and width of the stacks and in regard to the time of maturity of the crop from which the silage is to be made. It will also have to be determined whether the leguminous forage crops, such as alfalfa, soy beans, and cowpeas, can be put up in the same manner or whether they can be added in alternate layers in the stack, as is often done in the manufacture of silage in air-tight silos. The principal caution in putting up such stacks will be to see that no large cavities are left in the material, for wherever too much air has access the fermentation is liable to be carried to the putrefactive stage, following which molds will grow and render it very injurious, if not actually poisonous. These precautions are less necessary in the case of Johnson grass or broadcast sorghum, because the mass will be much more compact.

HAY.

In addition to putting up considerable quantities of stack silage, it is advisable that cattle owners provide hay, if a supply can be secured from natural or artificial meadows on the ranch. Very often stockmen who have not made this provision have to buy feed during winter, especially during the heavy snowstorms in the spring before the new grass has started and after the prairie grasses have either all been eaten off or have been rotted by rains or melting snows. In such cases hay often sells from $10 to $20 per ton and is hard to get in time to prevent losses. Prairie hay can be put up at the cost of usually not more than $1 to $2 per ton, using modern machinery and appliances. With the large number of kinds of hay grasses to choose from, any rancher who has fairly good land has no excuse for not putting up enough hay to carry his stock at least through the severer storms of the winter.

WATER.

Another precaution that must be taken, if the stock ranges are to be restored to anything like their former value, is that water must be provided in sufficient amount so that cattle will not have to travel long distances for it in times of severe drought. Nearly the entire western portion of Texas is underlaid by artesian waters ranging from 150 to 1,500 feet below the surface. Wherever the drainage slopes are not too precipitous, artificial tanks may be formed across the draws by building dams, and if the bottom of the tank is carried down to hardpan, or is puddled before being filled, a supply sufficient to last through the dry season may be secured at small expense. Such tanks, or wells, either artesian, or where the water is lifted by windmill pumps, should be provided at least every 4 miles over the range, so that cattle will never have to travel more than a couple of miles to water. Where the wells, water holes, or tanks are 8, 10, or more miles apart, as they very frequently are on some of the western ranges, cattle greatly overstock the range in the vicinity of the water, especially during midsummer, while the back country is thickly covered with good feed. Thus a portion of the range will be overstocked while another portion will be undergrazed. In the one case the grasses are eaten down and trampled for a few miles back from the water so that it may require several good seasons to undo the injury done in one bad year. In addition, the forage on the large area back from the water is entirely lost through not being grazed. The cost of constructing dams or providing windmills will often be but a small percentage of the loss incurred when no water is provided. It has been often observed that the period of flow of the rivers in countries which have been overgrazed is very much less than it was formerly. This is because the trampling of the herds has compacted the soil, and also because the waters are not retarded from running off the surface as they would be when the land is covered with a thick coating of grasses. Hence the drainage of the surplus water takes place in a very much shorter time. There are many streams and springs which in former years afforded a continuous supply throughout the dry season, which now only run during or immediately succeeding periods of abundant rainfall. Thus less dependence is to be placed upon the streams as a source of stock water. New artificial sources of supply must be provided.

GRAZING REGIONS IN TEXAS AND NEW MEXICO.

Texas may be divided into seven or eight well-defined agricultural provinces, each differing from the others in the general character of the soil and amount of rainfall. These differences of soil are mainly due to difference in geological formation, while the causes of the climatic variation are the natural phenomena which govern continental conditions, such as altitude, proximity to the Gulf, and presence or absence of vegetation. The areas or belts where soils and natural conditions are alike, or have only casual differences, are usually marked by the growth of certain plants, which form a characteristic, though not always the most prominent feature, in the grass flora. The region under discussion may well be divided along these lines and treated by areas.* These are:

The Coastal Prairies, bounded by a line drawn parallel with the coast about 70 miles back from the Gulf.

The Cactus Plains, which include all of the region between the Colorado and Rio Grande from the border of the coastal prairies to the "rim" of hills that breaks to the northward from San Antonio, just below the thirtieth parallel of latitude.

The Middle Plain, a low table-land, rather mountainous, extending from the southern "rim" to the Concho, and from the Colorado to the Pecos. This is the Edwards Plain of the geologists.

The Granite Region, occupying a very limited area in the center of the State between the central plain and the red prairies.

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* From data supplied by Prof. Robert T. Hill, of the United States Geological Survey.

The Red Prairies, extending from the Concho to the Red River, bounded on the east by the black lands and on the west by the Llano Estacado.

The Staked Plains, or Llano Estacado, a high level table-land which extends into New Mexico, containing the sources of all the rivers flowing to the eastward.

The Pecos Valley, an elevated valley which has the same soils as the red prairies, but a much smaller rainfall, so that the conditions are arid.

Before the ranges were overgrazed the grasses of the red prairies were largely blue stems or sage grasses (*Andropogon*), often as high as a horse's back. After pasturing and subsequent to the trampling and hardening of the soil, the dog grasses or needle grasses (*Aristida*) took the whole country. After further overstocking and trampling, the needle grasses were driven out and the mesquite grasses (*Hilaria* and *Bulbilis*) became the most prominent species. The occurrence of any one of these as the dominant or most conspicuous grass is to some extent an index of the state of the land and of what stage in overstocking and deterioration has been reached.

There is often a succession of dominant grasses in nature through natural causes, but never to so marked an extent as on the cattle ranges during the process of deterioration from overgrazing. Thus, the grasses in any given valley are liable to change in a long series of years through destruction by wood lice, prairie dogs, by fires, unusually early or late frosts, or by failure on the part of the plant to ripen seed. This latter contingency frequently occurs in the case of the big blue stem and feather sedge, and probably with some other of the Andropogon species. The curly mesquite will stand almost any amount of drought, trampling, and hard usage, but is easily killed and rotted out during a wet, cold winter. The drought-resistant needle grass is frequently destroyed by wood lice over considerable areas. This usually happens in the spring on burned areas after light local showers. Finally, the entire seed crop may be destroyed by early autumn fires. Thus it is seen that through some one of many natural causes a species of grass may be all but exterminated and its place taken by others, often of less value.

On overstocked lands there is uniformly an alternation of needle grass and mesquite at short intervals, unless the overstocking is carried too far, when these perennials give way to annuals and worthless weeds. The carrying capacity then depends almost absolutely on the proper distribution of rainfall through the growing season in order to bring this transient vegetation to its fullest maturity.

THE COASTAL PRAIRIES.

The low-lying prairies along the shores of the Gulf of Mexico constitute a region of very recent geological formation; in fact, so recent that many of the fossils contained in the strata are identical with the species now living in the waters of the Gulf. The alluvial plain is flat, swampy, and poorly drained, and is intersected by numerous sluggish streams with precipitous banks. The land is well grassed wherever it has not been overstocked, and the vegetation is very similar to that of the savannas and coastal plains in the Gulf States.

Along the immediate coast there is usually a sloping beach backed by a line of not very high nor very broad sand dunes. There are no drifting sand dunes to compare with those along the Atlantic coast except at intervals opposite the "passes" between the coastal barrier islands, where the winds and tides have free sweep from the ocean. Wherever the coast is protected from these by the islands, the only dune is about 100 yards back from high tide, perhaps not more marked than a narrow ridge, a few feet in height, whose surface is well covered with vegetation. On the land side of the dune there is usually a lagoon, and back of this a marsh containing numerous more or less parallel lagoons and sluggish water courses. This marsh extends from 2 or 3 to sometimes 15 or 20 or more miles back along the entire coast line from the mouth of the Sabine River to Aransas Pass.

The dominant grass on the beach between the ridge and the water is usually salt grass (*Distichlis spicata*). On the sand ridge there are *Eragrostis secundiflora*, salt grass, and slender cord grass (*Spartina patens*). On the seaward edge of the marsh, which is frequently inundated, the principal grass is *Monanthochloë littoralis*, a rough, wiry species with extremely short, harsh, and sharp-pointed leaves. This could never be called a turf grass, and yet its interlaced stems form the closest kind of a mat, extending from 100 yards to a mile or more inland, depending on the elevation of the land above high tide. Next in the succession is the bunch salt grass (*Spartina junciformis*) (fig. 1), which grows in great tufts 3 to 6 feet across and from 1 to 4 feet in height. The leaves of this are evergreen, harsh, and rather stiff, spiny pointed, and so sharp that they will make a horse's legs sore when he is ridden through or over it. The leaves are resinous, and will burn at any time during the year, smouldering along even through a shower of considerable violence. Between the tufts or tussocks the ground is either bare or covered with low rushes or other insignificant plants. The salt grass supplies fully 90 per cent of the vegetation of the marsh, and often occupies its surface to the almost total exclusion of other sorts.

These salt-grass meadows are well stocked with cattle. Unlike the salt grasses of the marshes along the Atlantic coast, this can not be mown for hay on account of its bunchy nature, and hence grazing is the only practicable method of utilizing the vast amount of forage produced. The bunch salt-grass marshes will carry from 80 to 120 head of stock cattle to the square mile. It is said to be a fine grass on which to *grow* cattle, but they can not be *fattened* on it; at least, that is the opinion of a stockman in Brazoria County who has ranged cattle

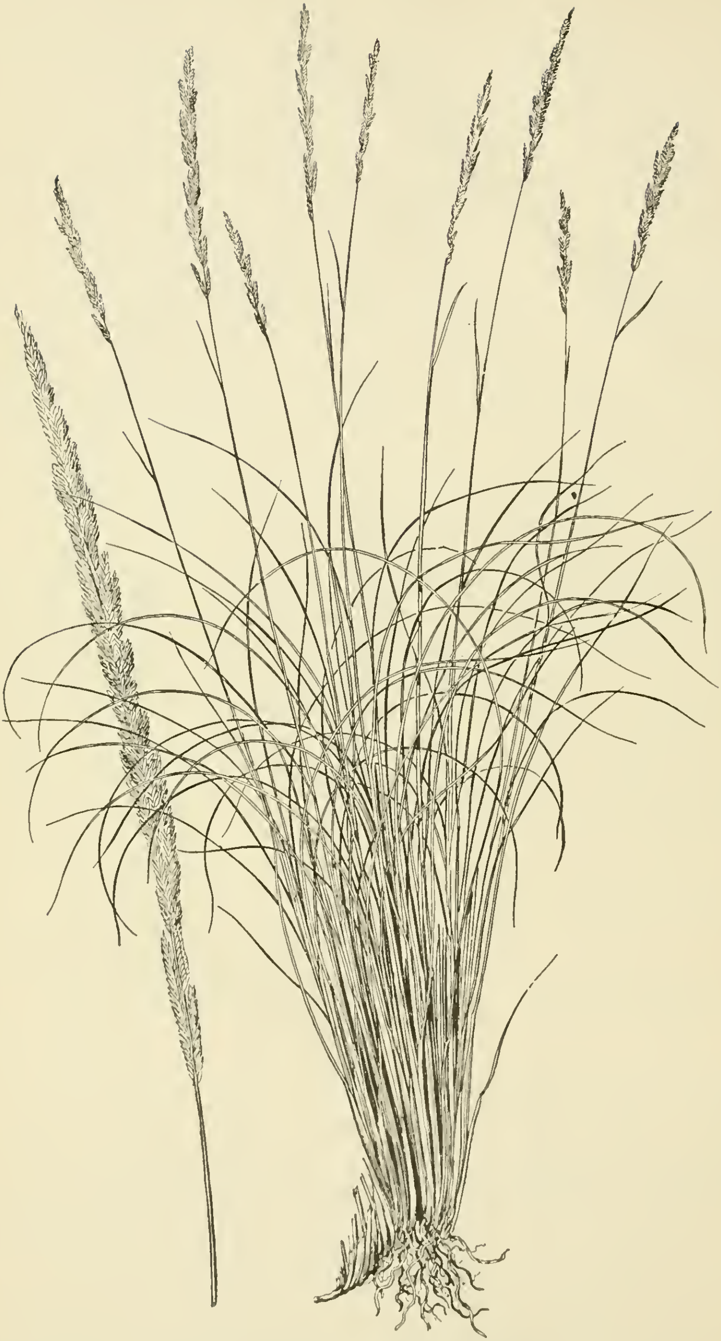

FIG. 1.—Bunch salt grass (*Spartina junciformis*)

on the marshes for forty-five years. When the stock are nearly matured they must be taken to the prairies farther inland or shipped to the fattening pens.

The only treatment ever given the marsh pastures is to burn them over at intervals of three or four years. This clears out the dead leaves and stems that fill the centers of the tussocks and acts as a fertilizer by adding a top dressing of ashes. Marsh soils are as a rule deficient in potash, and hence the marsh grasses need all that which is contained in the ashes. Summer burning should never be practiced on the salt marshes, because to destroy the entire plant to the roots at the time it is in its prime is simply to needlessly sap its vitality; whereas if the grass is burned in late winter or early spring while it is resting, before the new growth starts, the burning over will act as a stimulant to quicken the growth and increase the amount of vegetation.

The extent of salt marshes along the coast between the Sabine River and their southern terminus amounts to perhaps 1,000 square miles, which at the estimated grazing capacity as given above can support yearly between 80,000 and 120,000 head of cattle.

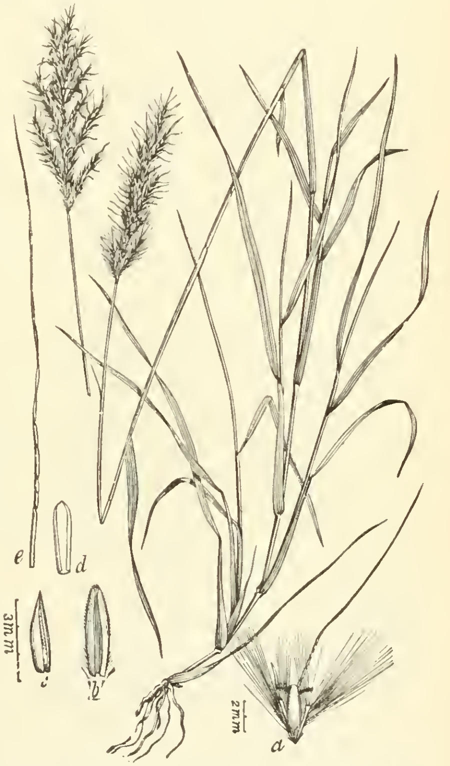

Fig. 2.—Torrey's sedge grass (*Andropogon saccharoides torreyanus*).

The best ranches in this section of the coastal plain are those which extend far enough back from the tide water to include some of the sedge grass prairies and wooded bottoms. The cattle may then be transferred from one character of pasture to another with the changing seasons, thus providing both variety of diet for the growing cattle and also securing that alternate grazing and resting which is most desirable in the formation of the best pastures.

The open prairies, where they still occur, are very fine grazing lands. They are covered with a great variety of species, it often being possible to gather fifty or more different kinds on a single section in one day. The most conspicuous of these are the sedge grasses: Feather sedge (*Andropogon saccharoides*), Torrey's sedge (var. *torreyanus*) (fig. 2), and big blue stem (*A. provincialis*). The first of these is very abundant and has caused the stockmen to refer to these meadows as the "sedge-grass prairies." However conspicuous these grasses may be, they are not the most abundant. There are a few spots where the sedge grasses occur so thickly that they make up fully 80 per cent of the vegetation. But in the majority of the coastal prairie pastures the sedge grasses do not amount to more than 10 per cent. On prairies at the mouth of the Brazos River buffalo grass (*Bulbilis dactyloides*) comprises about 60 per cent of the total, while rescue (*Bromus unioloides*), knot grass (*Paspalum compressum*), Bermuda (*Cynodon dactylon*), and smut grass (*Sporobolus indicus*) together amount to about 25 per cent. The remaining 15 per cent consists of from thirty to fifty species which occur as scattered individuals. The land is here more suited to agriculture than to stock raising. The rainfall is so heavy that the autumnal and winter grasses are frequently rotted instead of curing into hay on their own roots, so that it is necessary to provide winter feed.

The carrying capacity of the coastal prairies is probably on the whole about the same as that of the salt marshes, though they deteriorate from overgrazing, not because the soils become worn out, but through influx of weeds and sour grasses which gradually displace the better ones.

Farther down the coast, in Victoria, Calhoun, and Jackson counties, the three sedge grasses mentioned above constitute 40 per cent of the vegetation. Bearded mesquite (*Stipa leucotricha*) makes up fully 25 per cent, while honey dew (*Paspalum plicatulum*) amounts to 20 per cent. The other 15 per cent is made up as before of a great variety of forms, including knot grass, broad-leafed Bermuda (*Paspalum distichum*), wild barley (*Hordeum pusillum*), wild millets (*Chaetochloa*), switch grass, white grama, Colorado grass (*Panicum texanum*), and a score of others, all in great profusion of form, but no one species supplying any very large portion of the forage.

The grasses of the wooded bottoms are neither abundant nor nutritious, so that their grazing capacity seldom amounts to more than one-fourth as much as that of the open prairies. The dominant, and at the same time the most valuable, species is elm grass (*Panicum prostratum*). With this there occur Terrell grass (*Elymus virginicus*), wild timothy (*Phalaris angusta*), cotton-top (*Panicum lachnanthum*), and others. Here also in the dense shade occur numerous wild beans and what stockmen call a wild four-leaf clover (*Marsilia macropoda*), one of the fernworts, a relative of the Australian "Nardoo," which is also regarded as of some value as forage.

Between Rockport and the southern shore of Corpus Christi Bay the soil is black "hog-wallow" prairie extending to the beach, with no marsh intervening. Salt-water cord grass (*Spartina stricta*) replaces bunch salt grass to a considerable extent. It grows as well between high and low tide as farther back on the landward side of the marshes, and is here a rapid land-builder, continually advancing, forming little peninsulas which stretch out into the sea and cause shallows to form where driftwood and sediment are caught. The shore line is thus encroaching upon the waters of the bays. If this grass could be utilized artificially in the same way, a broad beach could be rapidly formed along the entire coast wherever there are existing shallows.

THE CACTUS PLAINS.

The black land coastal prairies end a few miles below Corpus Christi, where the transition between the "hog-wallows" and the "sands" is quite sharply marked. The southern Buffalo grass (*Bulbilis*) is the most common prairie grass, producing in many places fully 75 per cent of the forage. Bermuda grass is abundant along the streams and on the borders of tanks and ponds. The bur-grass (*Cenchrus tribuloides*) (fig. 3) is very plentiful, and is considered valuable up to the time when the burs are ripe. After that it is a great pest. Were it not for the burs this would be one of the best of the wild grasses, because it is one of the earliest to commence growth in spring and is also quite hardy. Cattle relish the herbage, usually eating it down closely, even before the surrounding taller grasses are touched. Bur-grass is now widely distributed and probably occurs in every county in Texas and New Mexico where sheep are grazed, the burs being widely disseminated in the fleeces of these animals. It is probable that its objectionable qualities as a weed quite outweigh its value for early spring feed.

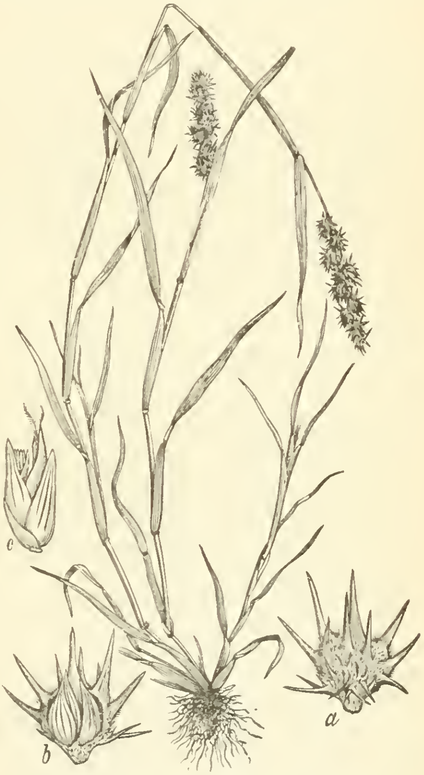

FIG. 3.—Bur-grass (*Cenchrus tribuloides*).

Dr. De Ryee, of Corpus Christi, states that the country between there and the Rio Grande was entirely open thirty years ago, sparsely grassed, and with only here and there a bunch of mesquite beans. Now all of the open spaces have been filled with thorn-thickets, often impenetrable to horsemen. In parts of Starr, Hidalgo, and Cameron counties the loose sands which comprise the surface soil are underlaid by fresh water at a depth of from 2 to 10 feet. The grasses here are mainly such as grow in bunches, like the needle grasses and bearded mesquites.

There is a low ridge or watershed parallel with the Rio Grande about 20 miles east of Laredo. From this ridge the land slopes both ways, forming a gradual descent to the east and a more abrupt one to the south and west. The east slope consists of a broad border of black alluvial soil along the river, then a strip of sands 60 miles wide, and then black "hog-wallow" prairie on the northern edge of the sands. Each of these soil formations has its peculiar grasses. At San Diego, which is on the western border of the arable soil, the dominant species are seed mesquite (*Bouteloua texana*) (fig. 4) and two gramas, *B. trifida* and *B. bromoides.* The occurrence of the gramas as the dominant species seems always to mark the transition from arable to pasture lands. Proceeding toward Laredo on the line of the Mexican National Railroad, the soil changes abruptly from gray-black to brick-red, and soon becomes almost pure sand. On these sands, as on the sands of Cameron County, the vegetation is largely bunch grass. There is still an open strip about 35 miles wide near Hebronville, but it is only a question of a few years before the brush and cactus will have advanced from both directions to take complete possession of it.

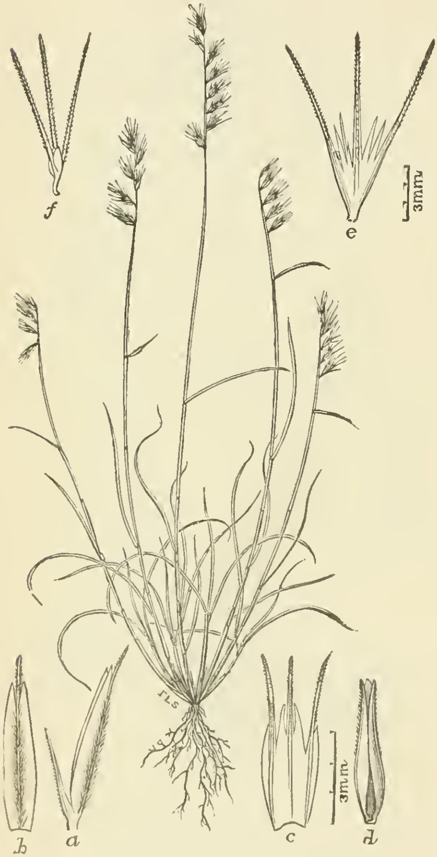

Fig. 4.—Seed mesquite (*Boutelaua texana*).

The valley of the Rio Grande is arid, receiving only a small amount of rainfall, poorly distributed, throughout the year. The soil is shallow, and sterile because of an insufficient supply of moisture. The vegetation consists of dense chaparral, with close thickets of various kinds of cactus, and the grasses are few and scattering. There is almost no water back from the river, and the brackish or salty underground flow lies from 200 to 300 feet below the surface. The carrying capacity of the chaparral-covered valley lands is never more than 30 head to the square mile. Grasses exist so sparsely that the destruction of brush and cactus by fire is almost out of the question, and could only be accomplished by sacrificing the grass accumulation of several years. The only practicable method of improving the conditions would be the introduction of forage shrubs from similar arid regions abroad, the construction of reservoirs or tanks to catch and hold the storm waters which descend as torrential rains, and the irrigation of the narrow valley. It is possible that the thornless Indian-fig cactus of Algiers and southern France could be introduced with profit into the Rio Grande Valley. A similar cactus is grown in the vicinity of Monterey, Mexico, and has been cultivated at Corpus Christi by Dr. William De Ryee and at Santa Gertrudes by Mr. R. J. Kleberg. However, this pear cactus is not frost-proof, like the native species. Dr. De Ryee states that the spines may be eliminated from the common species by pursuing the same course of treatment as that used in the production of the spineless form by the Mexican gardeners, who grow it for its superior fruit and not for its excellence as a forage plant. A young shoot or joint of the flattened stem taken before the spines are fully formed is set out in fertile soil. As soon as this has taken root and started to grow, a young cutting from the plant is treated in the same way, and so on, continuing for two or three seasons, always planting in rich and well-watered soil. By the third or fourth year the cactus will usually have lost all of its spines, so that there is nothing to prevent its being eaten by cattle. This Mexican cactus might be acclimated by the method of gradual transference each year a little farther north, and also by selection of the most hardy stocks; or, better, the same method of cultivation and improvement might be applied to cuttings of the superabundant Texan prickly pear with the view of securing an unarmed form of it for propagation in the arid portions of the State. The experiments would necessarily last through a long term of years, because the same care would be required in selecting hardy and drought-resistant spineless forms as in coaxing the plant to repress its spines. If the smooth form is transferred abruptly back to normal conditions of sterile soil and lack of moisture, the spines at once reappear, while both stem and fruit lose whatever points of excellence they may have acquired through cultivation. The experiment would have to be continued long enough for the acquired characters to become in some measure fixed. Such an improvement through cultivation would elevate the pear cactus to the rank of the cultivated plants. The rancher who wished to avail himself of it would have to grow the spineless forms on good rich soil, and sow the seed over the ranges at intervals of a few years. There would certainly be a return to the normal form in time, just as there is in the case of the carrot, or of the red pepper grown first on cultivated soils and then allowed to run wild, but if the spineless habit could become sufficiently fixed as a result of growth under improved environment the reappearance of sharp spines when the plant is grown on poor soil might be retarded several years. Such experiments ought to be undertaken, for if thornless cactus of some forage value could be grown in the place of the inedible wild varieties it would prove of immense pecuniary advantage to the stockmen of this portion of the State. A spineless form of the common prickly pear of India (*Opuntia dillenii*) is there used for forage, and it is reported that good silage has been made from a mixture of cactus and grass placed in the silo in alternating layers. A spineless pear cactus also occurs in South Africa, and is there used as forage.

Proceeding northward from Laredo the character of the land remains much the same for 50 miles, improving very gradually until the valley of the Nueces is reached. From the Nueces to the Guadalupe the soils are mainly rich black or chocolate loams, well grassed with an abundance of species, the curly mesquite predominating on the uplands, and Bermuda along the streams. The carrying capacity is high, ranging from 55 to 70 head per square mile, and, while held to have decreased from one-fourth to two-fifths on account of overstocking during droughts, the quality is now considered to be steadily improving. The chief means of betterment of the forage conditions here is the cultivation of hay and coarse forage such as sorghum, Colorado grass, cowpeas, alfalfa, and milo maize. Stack silage can also be used to advantage with cotton-seed hulls and meal for winter feeding.

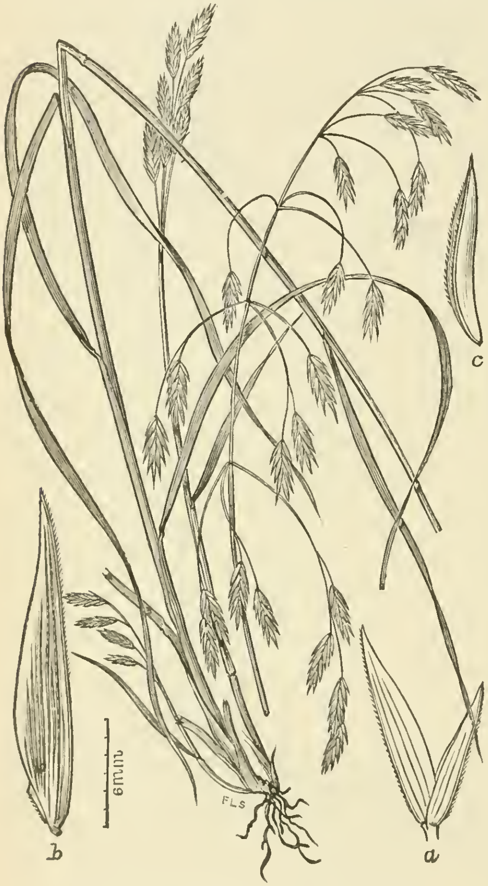

FIG. 5.—Rescue grass (*Bromus unioloides*).

THE MIDDLE PLAINS.

The region 100 miles west and 150 miles northwest from Bexar County is all broken country, with flinty limestone outcrops on lower slopes of the water sheds. The soils are patchy—black prairie loams on the backbone of the ridges, with gray, red, brown, chocolate, and black soils in the valleys and on the lower slopes. There are in parts of this region numerous and extensive gravel deposits of apparently lacustrine origin. Much of the section is quite mountainous. The rainfall is rather abundant, coming mostly during the spring and early summer months, but is not entirely limited to any one season, so that the conditions are excellent from the stockman's standpoint. This is a transition area as regards the grass flora. The striking grasses of the river valleys are those which thrive in the humid eastern portion of the State, including *Limnodea*, rescue grass (fig. 5), satin grasses (*Muhlenbergia*), *Uniola latifolia*, *Melica mutica*, wild rye and Terrell grass. The grasses of the uplands are the same as those of the prairies. The needle grasses compose 25 per cent of the total; seed mesquite and the two curly mesquites each 10 per cent, and side-oats grama, feather sedge, switch grass, wild millet, windmill grass, and species of *Triodia*, *Eragrostis*, and *Sporobolus* together supplying the remainder.

THE GRANITE REGION.

In the mountainous granitic area of Burnet, Llano, and Gillespie counties there are fewer turf-forming grasses and fewer well grassed pastures than in almost any other portion of the State. Bur grass is omnipresent, and the other species are in the main those of central Texas. A noticeable feature is the great abundance of leguminous plants. Vetches (*Vicia* and *Lathyrus*) and wild beans (*Phaseolus*) occur along every stream and in the scrub-oak copses. The buffalo peas (*Lupinus* and *Astragalus*) give color to the landscape in early spring, while in April the Texan pea (*Astragalus nuttallianus*) forms a thick growth over square miles of the granitic ridges. This area was originally more or less thickly covered with oak forest, and is now very brushy. The winter and spring pasturage is as good as anywhere in the State. The addition of good grasses to supplement the native legumes and supply summer and autumn feed would make this part of Texas the best grazing ground in the State, for there is plenty of water and good shelter at all seasons of the year. In times of drought the oak scrub is eaten by cattle and will keep them alive until the rains come. The mesquite beans are valuable at such times, as is also the mistletoe, which is parasitic on them. Mistletoe is said to be poisonous when fed to very young stock, and liable to cause abortion among cows, especially if eaten when other feed is scarce. The average carrying capacity of this mountainous area is about 40 or 50 head of cattle per square mile. The range could be improved by introducing upland alfalfa, Japan clover, Bokhara clover, and legumes adapted to rocky soils, and by devoting a larger acreage of the better valley lands to the cultivation of sorghum and Kafir corn or milo maize. In this and other portions of the State the unrestricted pasturing of hogs has been a potent factor in the destruction of the grasses. They not only disseminate seeds of the prickly pear more rapidly than would be the case were they kept within bounds, but they consume seeds, roots, and tubers of a variety of valuable plants to such an extent that many of the best are all but exterminated.

THE RED PRAIRIES.

To the northward of the middle plain and granitic area there lies a prairie region which slopes gently downward from the eastern edge of the Staked Plains, by a succession of steppes, to about the ninety-eighth meridian. This prairie region ranges from 1,200 to 3,000 feet in altitude and, while it is intercepted in the southern portion by a number of low mountainous ridges lying between the rivers, the bulk of the lands are level or gently rolling.

The entire region lying north of the Colorado and Concho rivers is well grassed and watered and is not overrun to such an extent by the mesquite bean and prickly pear as are the ranges farther to the southward. The chief pest and the one which causes the greatest destruction of grasses is the prairie dog, which, according to stockmen, is rapidly increasing in numbers, so that in some places the carrying capacity has diminished fully 50 per cent within less than ten years from this cause alone. This portion of the State, together with the Staked Plains, was formerly the winter feeding ground of a large part of the great southern herd of buffalo, and it is the portion which benefited most during the ten years immediately succeeding the destruction of the buffalo. The rainfall at Abilene, which may be taken as a central point from east to west, averages about 27 inches per year, although there has been a variation of from 11 to 35 inches during a series of twenty-five years. The rainfall of the region as a whole is probably between 20 and 30 inches, placing it within the category of semiarid sections. During average years cereals and cotton may be successfully grown, but the whole area is liable to suffer from severe droughts in off years, during which no dependence can be placed upon any of the cultivated crops. Such semiarid countries, no matter where they exist, can best be utilized in pasturing live stock, and the live-stock interests will always be the most important ones, even though certain of the more fertile valleys are converted into farm lands. The carrying capacity of the land here was formerly equal to the best. It is estimated that in 1880 the average for this whole region could not have been much less than 100 head per square mile, while picked sections would carry 320 head. Now it has been reduced to between 40 and 50 head, a fall of fully 50 per cent in the producing value of the land in the course of less than twenty years.

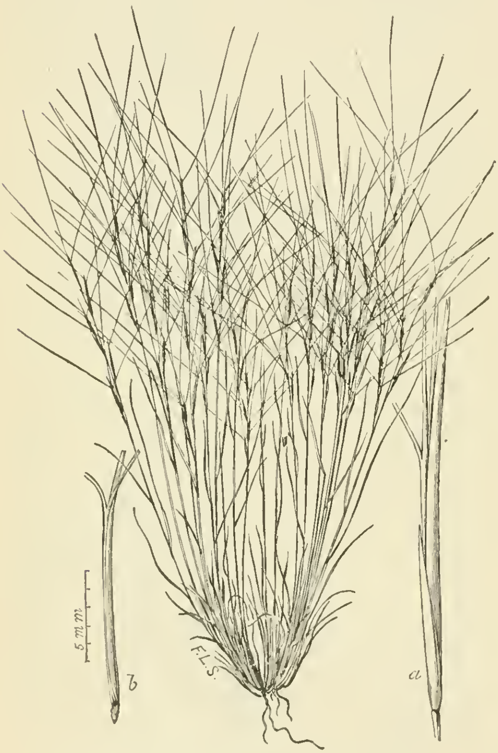

FIG. 6.—Needle grass (*Aristida fasciculata*).

The predominating grasses are the needle grasses (*Aristida fasciculata* and *A. coarctata*) which form fully 50 per cent of the entire grass vegetation, and more than that on the pastures which have been overgrazed. Stockmen consider the needle grass most nutritious and valuable, although many of the closely related species that occur in the Gulf States are there known as the much despised poverty grasses, held to be characteristic of the poorest land and all but worthless for pasturage. However, there is no doubt that here the needle grasses hold a position which could not be filled by anything else. They are the first to start growth in the spring, and after the sharp bearded seeds have fallen in autumn, cattle and sheep greatly relish the stems and leaves. The stalks remain green at the base long after the curly mesquite has become brown and dry. The bearded seeds undoubtedly cause some inconvenience to animals, especially to sheep. Losses among lambs are frequently reported through the needle-grass seeds piercing their skins or perforating their intestines. But aside from such trifling losses the fact remains that there is no grass which will spread so rapidly if only given a chance to ripen its seeds, as the three long beards attached to each enable it to be readily blown about by the winds. When the sharp point catches in loose earth the drying and wetting of the beards causes the seed to bore into the soil, burying it deep enough to insure germination. Wherever there is a ridge or mound of bare earth, or a furrow, the needle-grass seedlings grow abundantly.

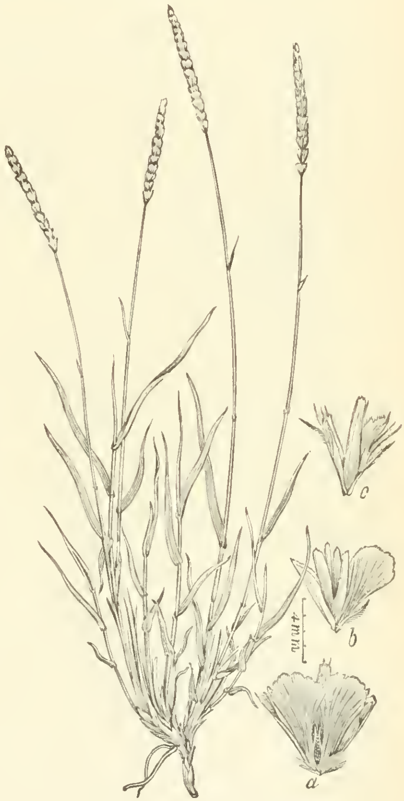

FIG. 7.—Black grama (*Hilaria mutica*).

The black grama (*Hilaria mutica*) (fig. 7) occurs quite abundantly in some of the valley pastures. It was formerly much more plentiful. It is one of the best of the winter grasses. Cattle do not seem to relish it in summer as long as there are tenderer annual grasses in abundance. Its stems and lower leaves remain green long after the first frost, and the whole plant cures on its own roots, forming first-class natural hay which is much relished in winter. Black grama hay was highly valued in the early days, but it is hardly ever found now sufficiently abundant to mow. The river valleys of this region are the original home of the Colorado grass or Texan millet (*Panicum texanum*), a leafy annual, whose merits as a hay grass have led to its becoming widely cultivated. Everlasting grass (*Eriochloa annulata*) and an Indian millet (*Panicum ciliatissimum*) also grow along the river bottoms and supply leafy herbage that is greatly relished by cattle.

The curly mesquite grasses (*Hilaria cenchroides* (fig. 8) and *Bulbilis dactyloides*) are omnipresent. They monopolize a large share of the range, supplying sometimes as much as 80 per cent of all the vegetation. Their long, creeping runners and short, crisp leaves form a matted sward that improves under an amount of abuse and hard usage that would kill out less hardy grasses.

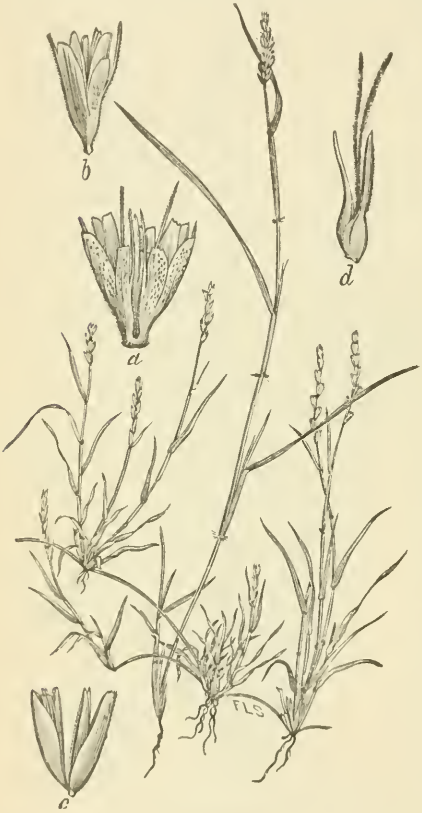

FIG. 8.—Curly mesquite (*Hilaria cenchroides*).

The blue grama (*Bouteloua oligostachya*) and side-oats grama (*B. curtipendula*) are abundant, forming a valuable factor of the range pasturage. The chief needs of the Red Prairie region are better winter and early spring forage. The former may be supplied by putting up fodder, hay, or stack silage.

To supply spring grazing the tallow weed (*Actinella linearifolia*) should be cultivated. This plant belongs to the tansy family. It is widely distributed in Texas and the Southwest, clothing the prairies with its bright yellow flowers and strap-shaped leaves long before any of the grasses have commenced to grow. Cattle and sheep are equally fond of it and its feeding value may be judged from the common name which it bears among stockmen. It is said that there is no wild forage plant which will put so much fat on an animal in so short a time. The tallow weed is truly a blessing to stock and stockmen, whose only criticism in regard to it is that there is not enough of it.

THE STAKED PLAINS.

The Llano Estacado or Staked Plains consist of an oblong plateau having a greatest width of about 180 miles from east to west, with a length of about 225 miles from north to south. This tableland lies approximately between the one hundred and first and one hundred and fourth degrees of longitude and between the thirty-second and thirty-fifth parallels of latitude. The altitude ranges from 3,500 to 4,500 feet, being greatest along the western border in New Mexico, thence sloping uniformly toward the southeast. The plains proper contain about 35,000 square miles in Texas and New Mexico. The surface is a succession of gently rolling hills with long ridges and valleys, the ascents being so gradual that they are hardly noticeable. The soils are mainly chocolate or reddish loams. Well water can be obtained almost anywhere within moderate depths from the surface. The northwestern border of the Staked Plains is more or less channeled with deep "arroyos" or canyons. The upper valleys of the Salt and South Forks of the Brazos River and of the Red River are very wide, showing that they formerly carried much more water than during recent years. The southern half is more sandy than the northern, with bare sand hills in Cochran, Terry, Yoakum, Gaines, and Anderson counties, Tex., and in eastern Chaves and Eddy counties, N. Mex. There are numerous brackish or saline lakes at about the geographical center of the plains, occurring through Gaines, Lynn, Terry, Hockley, Lamb, and Bailey counties, Tex. The entire region, with the possible exception of the sand hills, is admirably adapted for stock raising. It is well grassed with an abundance of species, and, while not watered by flowing streams as are the lower prairies bordering the Plains on either side, yet the configuration of the underlying strata is such that, as previously stated, an abundance of sweet water for stock purposes can be secured almost anywhere. The geological formation indicates that this entire region was formerly the bed of a great inland lake, and since its elevation in recent geologic times it has lost less by erosion and its character has undergone less change than the better-drained and better-watered prairies to the eastward. The soils are exceedingly rich, so that in good seasons or wherever water is near enough to the surface to be cheaply and abundantly raised by means of windmills for use in irrigation large crops of cereals, vegetables, fruits, and forage plants can be grown; but in ordinary seasons, or in the absence of water within moderate distance below the surface, the amount of moisture retained by the surface soils is not sufficient for the purposes of agriculture. The native grasses grow luxuriantly. The species are mostly identical with those which thrive on the high plains of western Kansas and Nebraska, consisting of wheat grass (*Agropyron spicatum*), little blue stem (*Andropogon scoparius*), side oats grama (*Bouteloua curtipendula*), blue grama (*B. oligostachya*), and buffalo grass (*Bulbilis dactyloides*). These species supply the larger part of the grazing, especially in the northern portion of the Plains. On the sandy lands in the southern half of the Plains, feather sedge (*Andropogon saccharoides*) coming up from the prairies of southern Texas displaces the little blue stem, and a number of other grasses identical with those of the Pecos Valley are abundant, including the two species of black grama (*Bouteloua eriopoda* and *Hilaria mutica*), and the southwestern species of *Sporobolus*, *Muhlenbergia*, *Aristida*, and *Panicum*. In the southern portion of the Plains the number of species of gramas (*Bouteloua*) increases and they, together with *Hilaria mutica*, form the bulk of the grass vegetation. The gramas of this region are *Bouteloua polystachya*, *B. oligostachya*, *B. eriopoda*, *B. vestita*, *B. curtipendula*, *B. hirsuta*, and *B. ramosa*. The number of species of *Sporobolus* also increases, and *Aristida arizonica*, *A. micrantha*, and *A. bromoides* take the place of the common dog-town needle grass (*A. fasciculata*) of the prairies. Because of the absence of running streams and surface water for stock purposes, the Staked Plains have been less severely overgrazed than the lower plains and prairies surrounding them. Now, however, since it is found that water is fairly abundant and within reach of windmill power, the land is being rapidly stocked. The grazing capacity is higher than in many other portions of the range country which have been stocked for a much longer period.

The best means of improving the range on the Staked Plains are, first, to provide stock water at intervals not greater than 4 or 5 miles apart, so that cattle will not have to travel more than 2½ miles in any direction; second, to provide winter shelter or protection from the storms which have uninterrupted sweep over this table-land during the winter months; and, third, to provide sufficient hay or coarse fodder to feed the cattle during the heavy storms.

On almost every ranch there will be found old lake beds, sinks, or shallow valleys where the soil contains enough moisture within reach of the surface to be readily available to the roots of cultivated plants. On such lands sorghum, Kafir corn, milo maize, the millets, and in especially favored localities alfalfa, and perhaps the soy bean, can be grown, and enough hay saved to provide against periods of shortage either during winter or in time of drought.

The carrying capacity of the Plains ranges from 40 to 64 head per square mile. Assuming the preposterously low figure of 30 head per square mile as the average annual grazing capacity, more than 1,000,000 head of cattle can be pastured. The capacity for improvement here is as great as in any other part of the Southwest, so that with a judicious use of the natural resources the number can easily be doubled or trebled within the next ten years.

THE PECOS VALLEY.

The Pecos Valley in New Mexico, extending almost due north and south, from about the thirty-fourth parallel to the southern border of the State, was formerly very well grassed. All of the living tributaries of the Pecos below Fort Sumner enter it from the west. For fully 200 miles below this point there is no stream of any importance which drains into the Pecos River from the direction of the Staked Plains. The lands in the valley are exceptionally well located for cultivation under irrigation, and several hundred thousand acres are under ditch, while it is estimated that 1,000,000 acres are capable of being thus improved.

The principal grasses in the Pecos Valley are salt grass (*Distichlis spicata*), in the alkali spots along the lowest portion of the valley, saccaton (*Sporobolus wrightii*), wild rye (*Elymus canadensis*), western wheat grass (*Agropyron spicatum*), and alkali grass (*Sporobolus airoides*). Back from the immediate river valley on the richer bottom lands blue grama (*Bouteloua oligostachya*) grows sometimes almost pure, or intermingled with woolly foot (*B. eriopoda*) (fig. 9), and black grama (*Hilaria mutica*). In the northern portion of the valley the grasses are practically identical with those of the northern half of the Staked Plains. The gramas are the most abundant, supplying fully 80 per cent of the entire forage of the ranges, the balance being furnished by perhaps twenty-five or thirty species. The carrying capacity of the ranges in the Pecos Valley varies more widely than in any region in Texas, because of the unrestricted grazing of cattle and sheep on the public lands. In dry years there are often areas where 60 acres would hardly support 1 cow, while in good seasons the same lands if undergrazed in the droughty seasons will support from 40 to 60 head to the square mile.

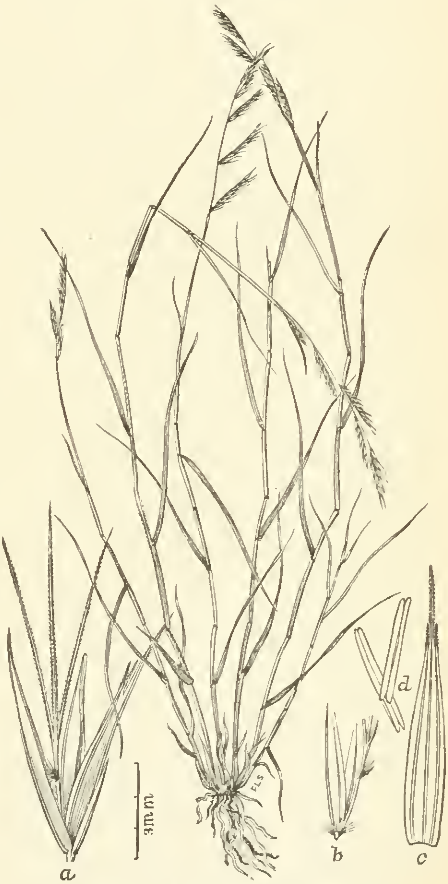

FIG. 9.—Woolly-foot (*Bouteloua eriopoda*).

RELATION OF LAND LAWS TO RANGE IMPROVEMENT.

The range lands in New Mexico, with the exception of frontages along streams, sections, or quarter sections containing springs and land which may be artificially watered by shallow artesian wells, are still owned by the Federal Government, 69 per cent of the territory being Government land, and 58 per cent is classed as grazing lands, amounting to 45,000,000 acres. Texas having been independent previous to its annexation to the United States contains no public land other than that belonging to the State, and the use of pasture lands within its borders is regulated entirely by State land laws. With the exception of California it is the only one of the Western States where the ownership of the ranges does not lie entirely in the National Government. The only way in which the nonmineral lands can be filed upon is either under the right of preemption, under timber claim laws, desert land laws, or those relating to irrigated lands. There is no system for disposing of areas unsuited for agriculture other than under some one of these laws, and the result is that the grazing lands are held as commons open to any stockman who can run his cattle upon them. *There is no law which recognizes the existence of pasture lands or in any way provides for their management and disposal.*

The problem of range improvement in New Mexico, and in every one of the Western States and Territories where there are still large bodies of Government lands, is not wholly the introduction of new and better grasses nor the cultivation of better forage crops. The first and foremost necessity, if the extravagant waste of the public domain is to be prevented, is to devise some system by which grazing lands can be placed in a class separate from agricultural lands, and under which property rights in lands now free to everyone may be assumed by individual stockmen.* It has been the experience in all pastoral countries that proper care and conservation of the forage resources can only be secured and will only be practiced where the tenure of the land is sure. The necessary fixity of tenure might be legally provided for by long-term leases directly from the General Government at a nominal rental per acre.

As it is at present, the value of the grazing on the public lands depends almost entirely upon such matters as seasonal rainfall and accessibility. The winter of 1896–97 was accompanied by exceptionally heavy rainfall over almost the entire southern and eastern portion of New Mexico. This combined with the extraordinary shortage of cattle on the ranges permitted the rapid development of the range grasses, so that during 1897–98 the supply of feed was unusually large; and, whereas the southern portion of the valley not having received any more than the normal precipitation, would not carry in the spring of 1897 more than 10 to 20 head per square mile, the upper portion of the valley at the same period was covered with grasses and would have carried at least 50 head to the mile on almost any portion of it.

Aside from the effect of overgrazing on the lands themselves and on the natural grasses with which they are covered, it is well to note that millions of cattle and sheep are grazed on free lands in every Western State and Territory. These lands contribute no taxes for the support of the State governments. The cattle when marketed may be sold at a much lower figure than those raised on taxed lands owned by the stock grower and still make a profit. It is not fair to the people who are compelled to bear the expenses of local government for large untaxed areas, nor on the other hand to the cattle men and woolgrowers of the East whose products come into competition with those grown almost without expense on free Government lands. The policy which governed the settlement of the prairie States might well be modified to meet the demands of the stock raisers, especially as a very large percentage of the Government land now remaining is not agricultural and can not be made so by irrigation. The best policy is that which will the best promote permanent settlement. It is necessary that timely action shall be taken to open up the public lands for settlement in tracts extensive enough to encourage men to build ranches and make permanent improvements upon them. The continued existence of great bodies of free lands covered with free grass is demoralizing to all those who take advantage of the opportunities presented thereby. As suggested above, probably the most feasible plan would be to provide for long-term leases of the public lands for grazing purposes.

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* F. V. Coville, in Forum, September, 1898.

BENEFITS OF IMPROVING THE RANGES.

The number of cattle owned in the State of Texas on January 1, 1899, was estimated at 4,533,897 head, valued at $76,665,937. At the same time there were 2,513,917 head of sheep, valued at $4,448,039, and 1,137,015 horses, valued at $20,088,788. The total value of sheep, horses, and cattle, exclusive of milch cows, at that date was $101,202,764. Nearly all of the sheep and a majority of the cattle and horses were grazed or fed within the territory included in this report. It can be safely taken as correct that 75 per cent of the 8,215,000 of live stock of these three classes is pastured on an area of less than 200,000 square miles, or, in round numbers, about six and one-fifth million head of stock are pastured on one hundred and thirty million acres of land. Now, if by any of the methods which have been suggested here, or by any treatment which may be devised, the carrying capacity of these arid land pastures could be improved and increased even to the extent of 25 per cent, it would mean an increase in taxable values of the State of at least $25,000,000. It is the opinion of a majority of stockmen who have raised cattle and sheep in Texas and New Mexico during the last twenty-five years that there has been a marked decrease in the amount and value of the natural forage, resulting in a proportional decrease in the number of cattle grazed. As has been stated above, an average of decrease taken from estimates made by 300 stock owners in Texas in 1897 was about 40 per cent. There is no doubt whatever in the minds of men who have studied the capabilities of the Texas soils that the lands themselves are nearly as fertile as they ever were. In fact, it is a general law that the lands in exclusively pastoral countries are continually improving in fertility as opposed to lands devoted to the cultivation of cereal and staple crops, because little of the essential mineral ingredients are removed, while the organic matter in the soils is steadily increased. Forty per cent of increase over present capacities is not an improbable one, and there are many of the more sanguine stockmen who believe that the grazing capacity of large areas can be increased 100 per cent by undertaking proper methods of treatment. Such improvement will undoubtedly be slow, but the results will justify the effort.

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BULLETIN No. 17. (Agros. 40.)

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF AGROSTOLOGY.
[Grass and Forage Plant Investigations.]

AMERICAN GRASSES—II.

(ILLUSTRATED.)

BY

F. LAMSON-SCRIBNER,
AGROSTOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., April 8, 1899.

SIR: I have the honor to transmit herewith the manuscript and illustrations for "American Grasses—II," and recommend its publication as Bulletin No. 17 of this Division. "American Grasses—I" was published as Bulletin No. 7, and contained illustrations of 302 species. In this second part 325 additional species are described and illustrated, making a total of 627 species. Many of our grasses are here illustrated for the first time, and as a whole it is believed that the work will be helpful to students of grasses in determining the species of this most important family of plants. In the preparation of this part more attention has been given to synonymy and to the citation of authorities, and the descriptions have been extended in order to facilitate identification.

Of the species now illustrated, 19 may be regarded as characteristic of the Atlantic Coast region, 83 to the region of the Gulf of Mexico, 92 to the Southwest, including the States of Texas, New Mexico, Arizona, and southern California, 74 to the States of California, Oregon, and Washington, and 61 to the Rocky Mountain region, of which 19 may be regarded as more properly the prairie species of that region. The distribution of some of the species is very limited, while that of others may extend throughout all the States and even to other countries.

The genus *Blepharoneuron* Nash is here recognized, while *Stapfia* Davy is referred to *Anthochloa* Nees. A few species are here published for the first time, and a number of those recently described as new, particularly of the genus *Panicum*, are included more for the purpose of calling attention to them than as an expression of the acceptance of their validity. In the two parts eighty-seven species of Panicum are illustrated, many of them by drawings made from type specimens.

For information concerning the forage or other economic values of the species described, reference is made to previously published bulletins of the Division, especially to Bulletin No. 14. The illustrations are of the same character as in American Grasses—I (Bulletin No. 7), and have been executed by the same artists.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

AMERICAN GRASSES—II.

(ILLUSTRATED.)

BY F. LAMSON-SCRIBNER.

METRIC MEASUREMENTS AND THEIR ENGLISH EQUIVALENTS.

The metric system adopted in this bulletin, as in No. 7, is now quite generally employed in botanical and other scientific publications. For those unfamiliar with this system the following expression of equivalents may be useful:

1 millimètre (1 mm.) = one twenty-fifth of an inch—exactly 0.0394 inch.

1 centimètre (1 cm.) = nearly one-half of an inch; 10 cm. = about 4 inches.

1 décimètre (1 dm.) = about 4 inches, or 3 dm. = 1 foot.

1 mètre (1 m.) = about 3 feet $3\frac{3}{8}$ inches—exactly 39.37079 inches.

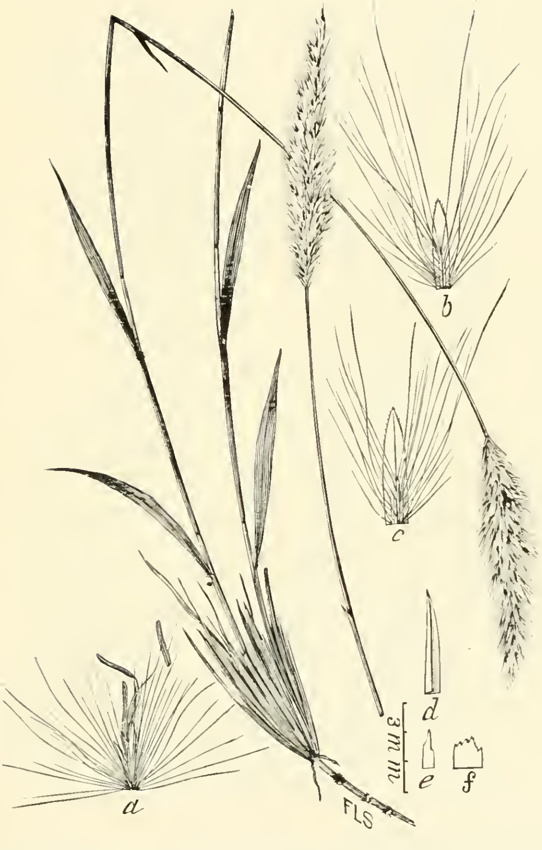

FIG. 303. **Imperata brasiliensis** Trin. in Mém. Acad. Pétersb. VI, **2** : 331 (*I. caudata* Chapm. Fl. S. St. 668, not Trin.). BRAZILIAN BLADY-GRASS.—A rather slender, erect perennial, 3 to 7 dm. high, with narrow, white-hairy panicles, 6 to 12 cm. long, and linear-lanceolate leaves, 10 to 30 cm. long. Spikelets linear, about 4 mm. long, the outer glumes (*b* and *c*) clothed with long hairs from the base to near the middle.—Rich, dry soil, Southern Florida. [Mexico and South America.] May.

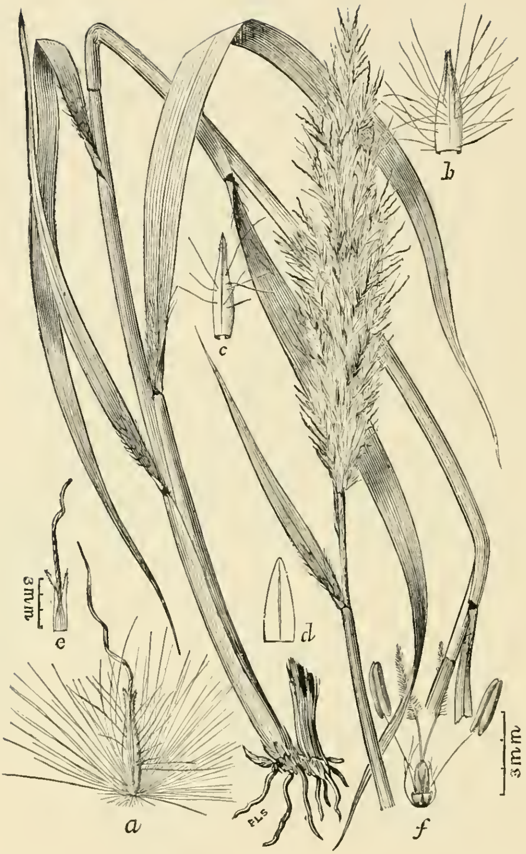

FIG. 304. **Erianthus alopecuroides** (L.) Nash in Britt. & Brown. Ill. Flor., **1**: 98, not Ell. (*E. contortus* Ell. Sk. Bot. S. Car. & Ga. 1, 40. *E. saccharoides contortus* Hack.) SPIRAL-AWNED PLUME-GRASS.—A stout, erect perennial, 2 to 3 m. high, with long leaves and hairy, bearded panicles 15 to 30 cm. long. Spikelets (*a*) 6 to 7 mm. long; the deeply cleft fourth or flowering glume (*e*) with a stout, twisted awn 14 to 18 mm. long; hairs as long as or exceeding the spikelet.—Low moist grounds, New Jersey to South Carolina and westward to Texas. September.

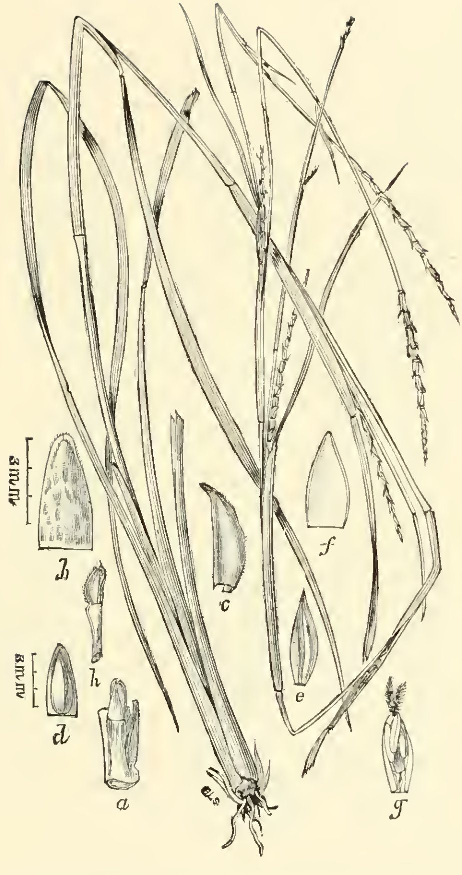

Fig. 305. **Manisuris corrugata** (Baldw.) Kuntze. (*Rottboellia corrugata* Baldw. in Sill. Journ. **1**: 355. 1819.) Tall Rat-tail-grass.—A stout, erect perennial, 1 m. or more high, with flattened culms and sheaths, subcylindrical, spike-like racemes, 6 to 8 cm. long, terminating the branches from the upper joints of the culm. Sessile spikelets, 5 to 6 mm. long, with transverse ridges and irregular depressions on the back of the first glume (*b*).—Swamps and wet pine barrens, Fla. to Miss. Sept., Oct.

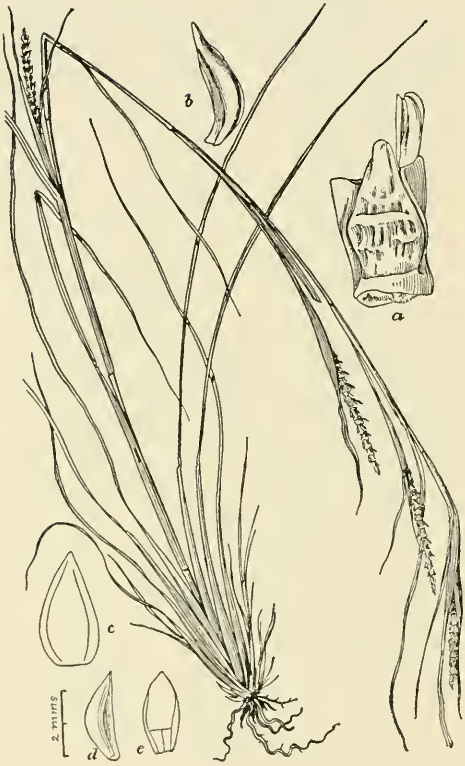

FIG. 306. **Manisuris rugosa** (Nutt.) Kuntze, Rev. Gen. Pl. **2**: 780. 1891. (*Rottboellia rugosa* Nutt. Gen. **1**: 84.) ROUGH-FLOWERED RAT-TAIL-GRASS.—A rather stout perennial, with compressed culms 1 to 2 m. high, narrow leaves 30 to 50 cm. long, and slender terminal and axillary racemes 4 to 5 cm. long. Outer glume of the sessile spikelet about 4 mm. long and strongly transversely rugose.—In moist or wet soil from Delaware to Florida and Alabama, and westward to Texas, chiefly near the coast. August–October.

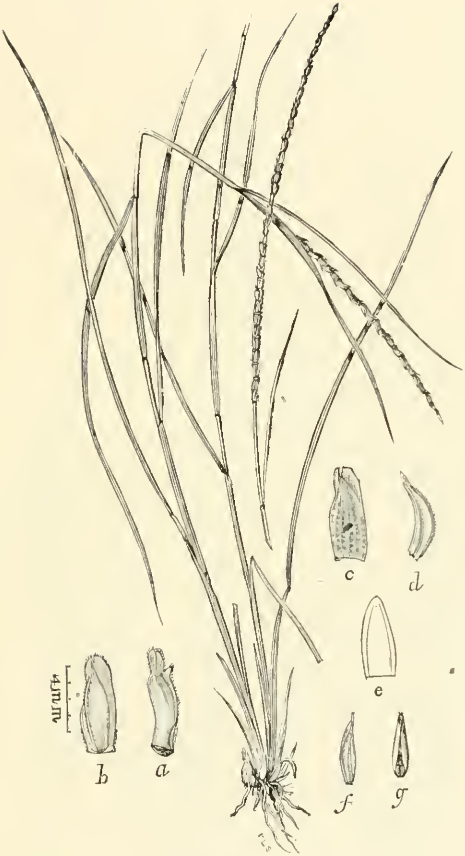

FIG. 307. **Manisuris cylindrica** (Michx.) Kuntze, Rev. Gen., Pl. 779. 1891. (*Tripsacum cylindricum* Michx.; *Rottboellia cylindrica* Torr., Chapm.). SLENDER RAT-TAIL-GRASS.—A slender perennial with nearly terete, erect culms 60 to 90 cm. high, narrow leaves 15 to 30 cm. long, and cylindrical spike-like racemes 12 to 18 cm. long. Sessile spikelet (*b*) 6 to 7 mm., long with the first glume (*c*) firm in texture and slightly pitted on the back.—Prairies, Florida to Arkansas, Oklahoma, Indian Territory, and Texas. June–September.

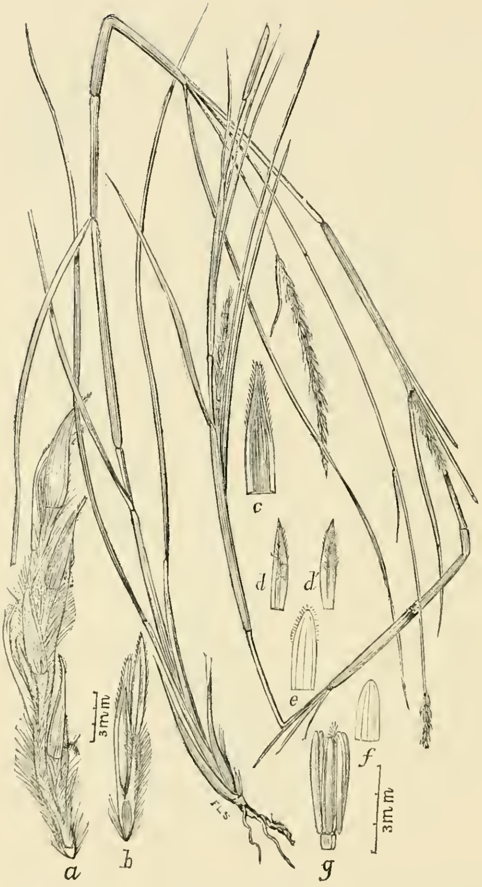

Fig. 308. **Elionurus tripsacoides** Humb. et Bonpl. ap. Willd. Sp. Pl. **4**: 941. 1805. (*Rottboellia ciliata* Nutt.) A stout, branching perennial 7 to 12 dm. high, with narrow leaves 15 to 50cm. long, and slender, more or less pilose racemes 8 to 14 cm. in length. Sessile spikelet lanceolate, 7 to 10 mm. long, with the first glume (*c*) glabrous on the back or shortly pubescent near the base.—Low pine barrens and marshy grounds, Florida to Texas. [South America.] August, September.

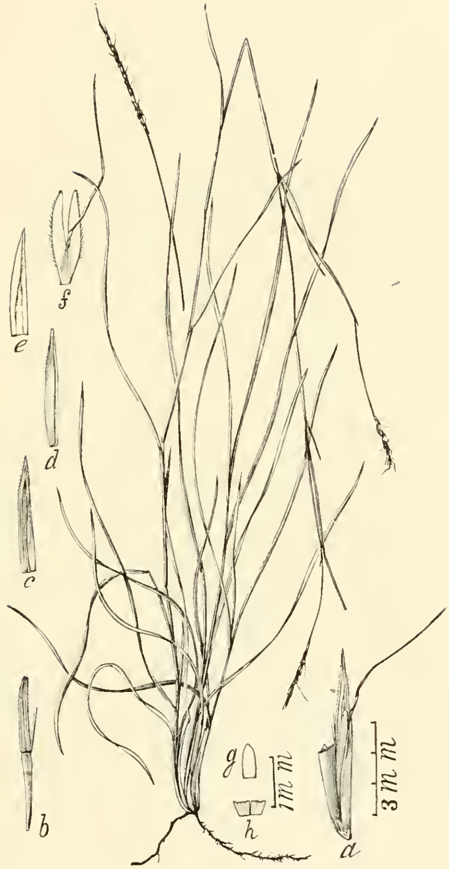

Fig. 309. **Andropogon tener** Kunth, Revis. Gram. **2**: 565. Beardless Broom Sedge.—A slender perennial grass 2 to 6 dm. high, with long, narrow leaves, and very slender racemes 3 to 6 cm. long. Sessile spikelet (*a*) 4 to 5 mm. long, with the ciliate and deeply cleft fourth glume (*f*) bearing a slender awn 8 to 14 mm. long.—Dry sandy hills and pine barrens, Florida, Alabama, and Mississippi to New Mexico. [Cuba, Mexico.] July–September.

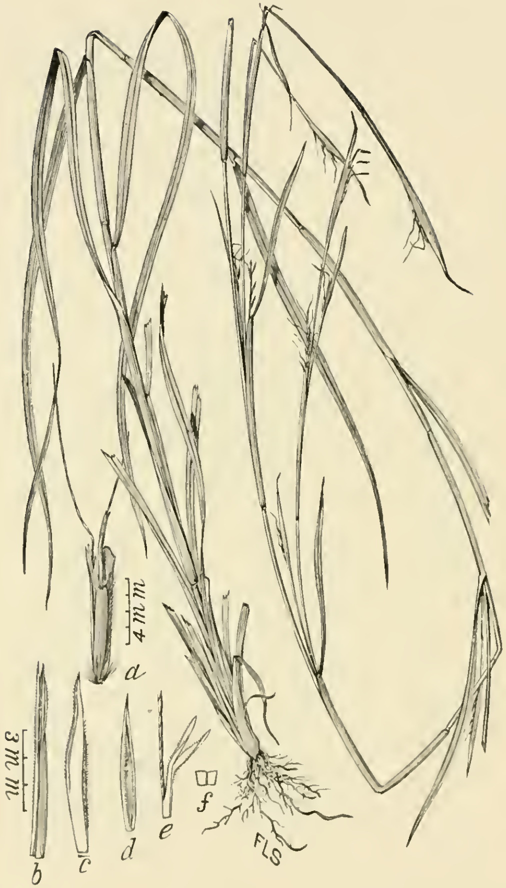

FIG. 310. **Andropogon semiberbis** Kunth, Enum. **1**: 489. (*A. tener* Curtiss, N. Am. Pl. No. 3633, not Kunth.) SHORT-BEARDED BROOM SEDGE.—A rather stout, cæspitose perennial 6 to 10 dm. high, with narrow leaves and slender racemes 8 to 12 cm. long. Sessile spikelet (*a*) 7 to 8 mm. long, with the slender awn of the deeply cleft fourth glume (*e*) 10 to 16 mm. long.—Florida to New Mexico and Nevada. [Cuba, Puerto Rico.] September–April.

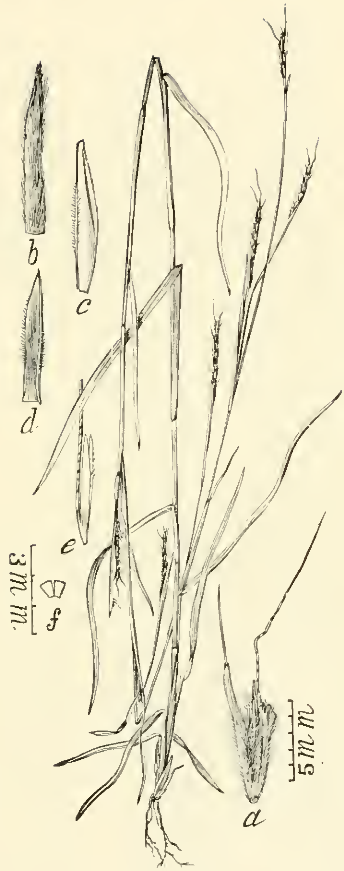

FIG. 311. **Andropogon hirtiflorus oligostachyus** (Chapm.) Hack. in D. C. Monog. Phan. **6**: 372. (*Andropogon oligostachyus* Chapm.) A slender perennial 6 to 12 dm. high, with narrow leaves and slender racemes 5 to 6 cm. long. Sessile spikelet (*a*) 6 to 7 mm. long with the first glume (*b*) hirsute, and the deeply cleft fourth glume (*e*) bearing a slender, geniculate awn about 15 mm. long. Florida, Arizona. [St. Domingo and Mexico.] July–September.

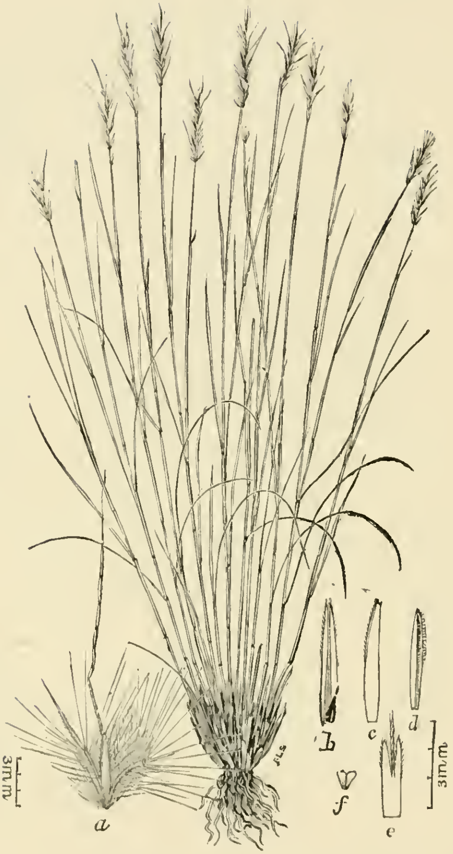

Fig. 312. **Andropogon gracilis** Spreng. Syst. **1**: 281, not Presl. SLENDER BROOM SEDGE.—A slender, erect perennial 3 to 4 dm. high, with thread-like leaves 10 to 20 cm. long and terminal, silky-hairy racemes 3 to 5 cm. long. Sessile spikelet (*a*) 4 to 6 mm. long, with the awn of the flowering glume (*e*) 13 to 19 mm. long.—Dry pine woods, Southern Florida. [West Indies.] June–August.

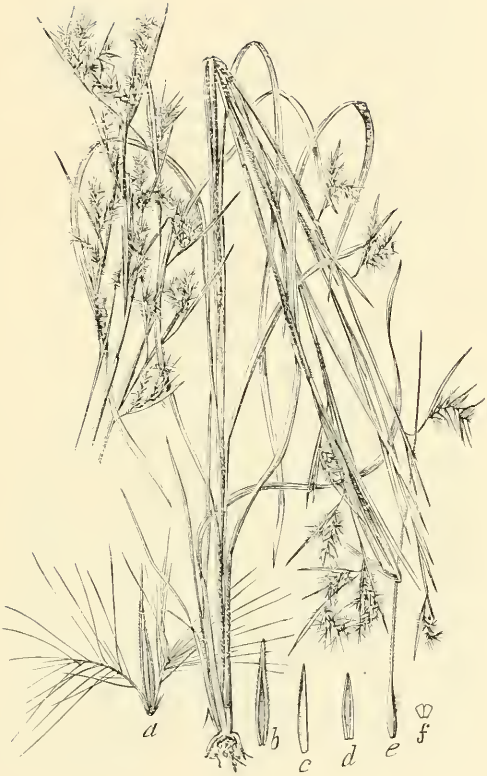

FIG. 313. **Andropogon virginicus tetrastachys** (Ell.) Hack. in DC. Monog. Phan. Prod. **6**; 411. (*A. tetrastachys* Ell. *A. curtissianum* Steud.) MANY-FLOWERED BROOM SEDGE.—A tall, slender variety with the leaf-sheaths often villous above and the lower leaves very villous. Panicles 30 to 50 cm. long, sessile spikelets 4 to 4.5 mm. long, awns 16 to 20 mm. long.—Moist pine barrens and old fields, Florida, Alabama to Mississippi. September, October.

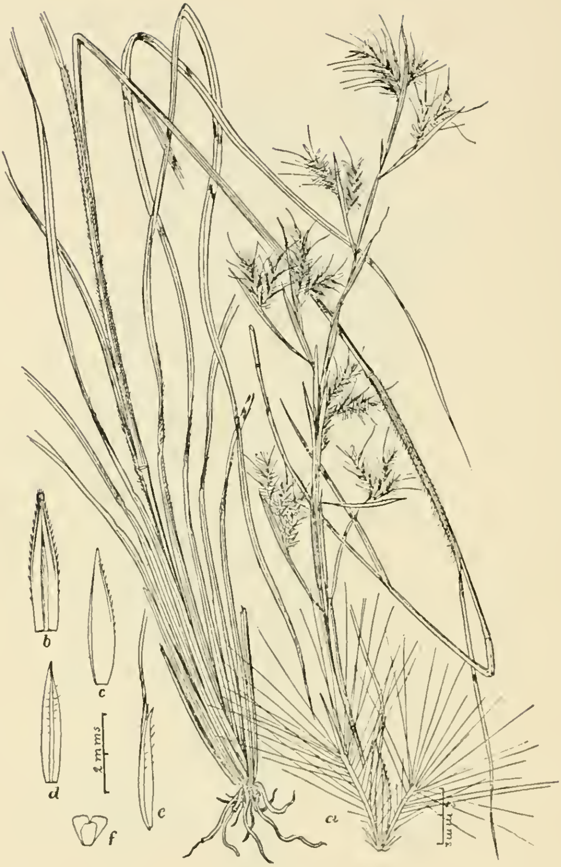

Fig. 311. **Andropogon mohrii** Hack. Contrib. U. S. Nat. Herb. **3**: 11. 1892. (*A. liebmanni mohrii* Hack. in DC. *Monogr.* Phan. **6**: 413. 1889.) Mohr's Broom Sedge.—A stout, erect perennial, 10 to 15 dm. high, with densely villous sheaths and leaves, and lax panicles 50 to 60 cm. long. Sessile spikelets about 4 mm. long, with the narrow fourth glume bearing a slender awn about 20 mm. long.—Low pine barrens, Alabama, Mississippi, and Louisiana. October, November.

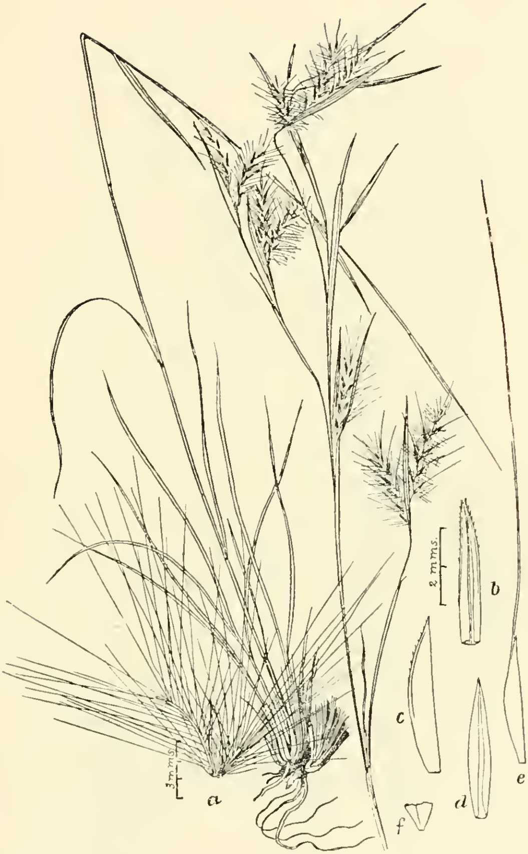

Fig. 315. **Andropogon longiberbis** Hack. Flora, **68**: 131. 1885. (*A. tetrastachyus* var. *distachyus* Chapm.) Long-bearded Broom Sedge.—A slender grass, 6 to 8 dm. high, with compressed, silky-villous sheaths, comparatively short and narrow leaves and slender panicles, 20 to 30 cm. long. Racemes 3 cm. long. Sessile spikelets 4 to 4.5 mm. long, somewhat broader than in *A. virginicus*, with the shortly 2-toothed fourth glume (*e*) bearing a slender awn about 16 mm. long.—High pine lands, Florida. May, June.

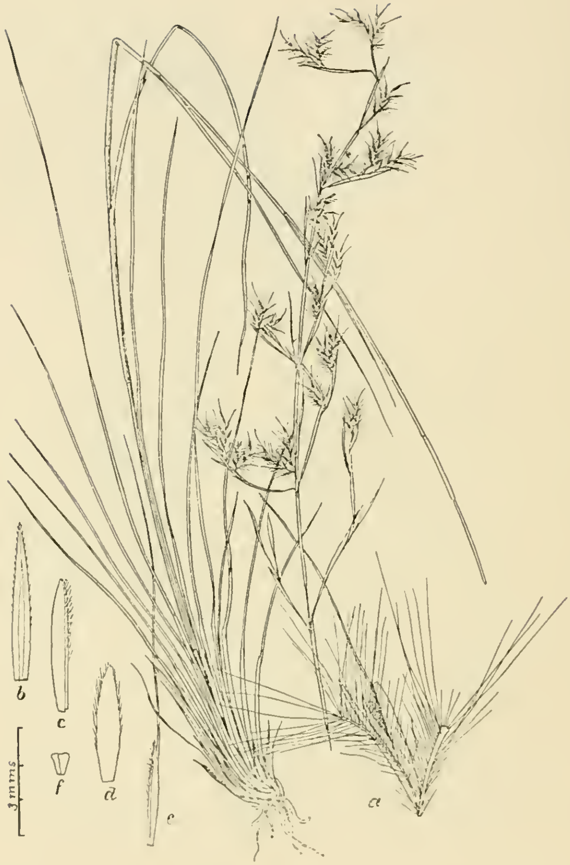

Fig. 316. **Andropogon brachystachys** Chapm. Fl. S. St. Suppl. 668. Short-spiked Broom Sedge.—A stout, erect perennial 12 to 15 dm. high, with rather long, very smooth leaves and narrow, much branched panicles 60 to 70 cm. long. Racemes in pairs, 1.5 to 2 cm. long. Sessile spikelet narrow-lanceolate, about 5 mm. long with the first glume (*b*) very acute, the fourth glume (*e*) bearing a slender awn 7 to 8 mm. long.—Pine barrens, Florida. September, October.

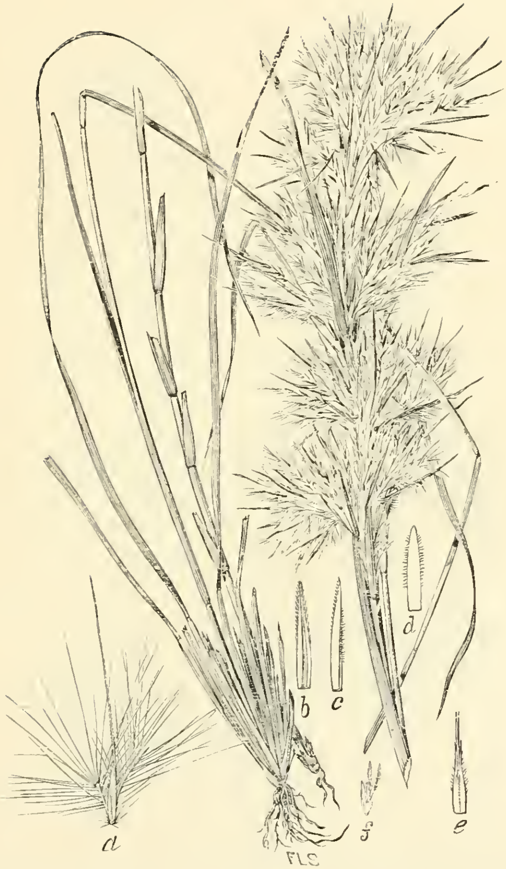

FIG. 317. **Andropogon glomeratus** (Walt.) B. S. P. (*Cinna glomerata* Walt. Flor. Car. 39. 1788; *A. macrourus* Michx.) BROOK-GRASS.—A stout perennial 6 to 12 dm. high. Fertile spikelets 4 mm. long.—Low grounds New York to Florida, westward to Texas, New Mexico, and Nevada. [Mexico, Lower California, Cuba, and Jamaica.] September–November. NOTE.—Another form of this species is figured in Bull. 7.

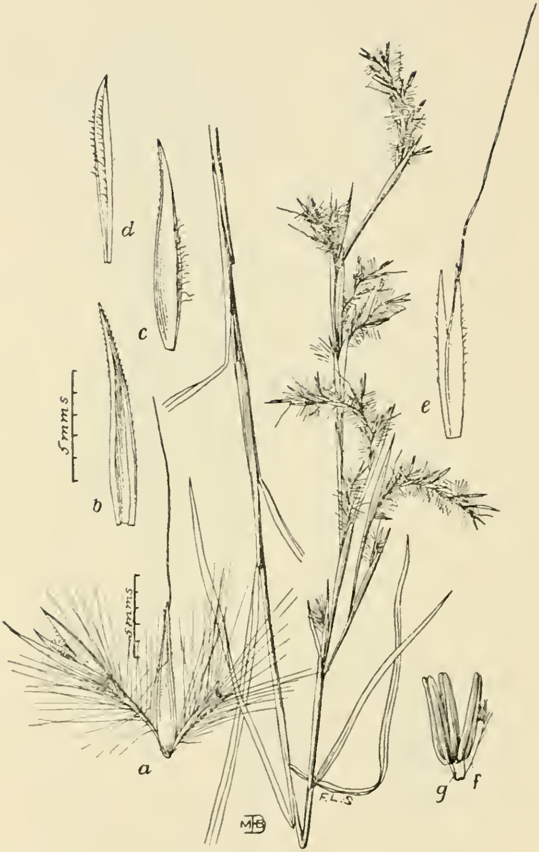

FIG. 318. **Andropogon maritimus** Chapm. Fl. S. St. Suppl. 668. (*A. scoparius maritimus* Hack.) SAND BROOM SEDGE.—A rather slender perennial, with numerous, abruptly reflexed and glabrous leaves 5 to 10 cm. long, and stout racemes 4 to 5 cm. long; sessile spikelets 10 mm. long, with the bifid fourth glume (*e*) bearing an awn about 13 mm. long.—Sand dunes along the coast, west Florida to Mississippi. September–November.

A good sand binder. Allied to *A. scoparius*, but quite distinct.

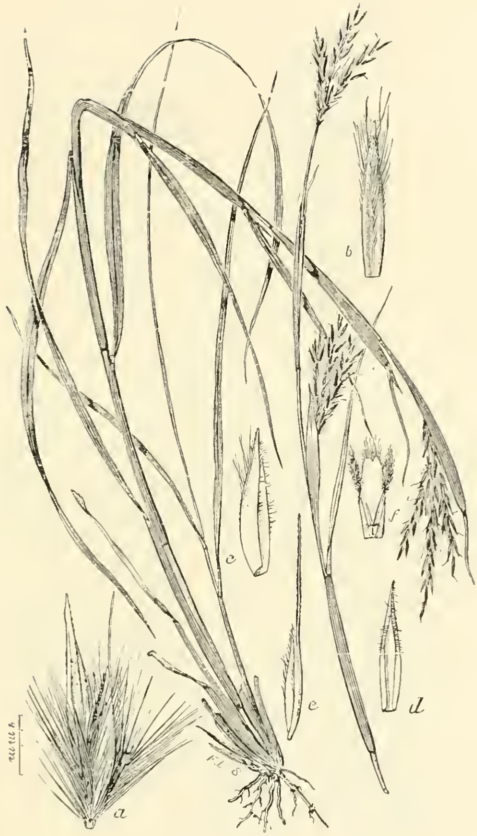

Fig. 319. **Andropogon hallii Hack.** Sitzungsber. Ak. Wiss. Wien, **89**: 127. 1884. Colorado Sand-grass.—A stout, glabrous perennial 4 to 10 dm. or more high, with rather long (the lower 10 to 20 cm.), flat leaves and stout racemes which are in pairs or in threes and 5 to 8 cm. long. Sessile spikelet (*a*) about 8 mm. long, with the first glume (*b*) ciliate along the keels and pilose-hairy toward the apex. Awn shorter than the spikelet or wanting.—Dry sandy soil, North Dakota, Montana, southward to Kansas, Texas, and New Mexico. [Mexico.] July–September.

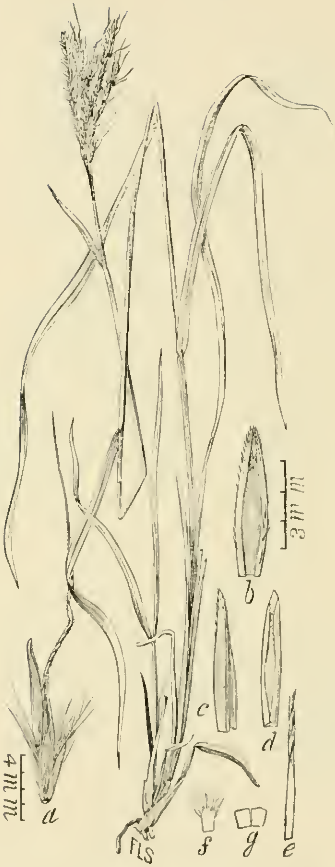

Fig. 320. **Andropogon wrightii** Hack. in Flora, **68**: 139. 1885. Wright's Broom Sedge.—A slender, erect perennial 5 to 8 dm. high, with long, flat leaves 15 to 20 cm. long, and 3 to 4 digitate or subfastigiate racemes about 4 cm. long. Sessile spikelet 5.5 to 6 mm. long, with the very narrow fourth glume (*e*) bearing a slender awn 12 to 13 mm. long.—Dry mesas, New Mexico. [Mexico.]

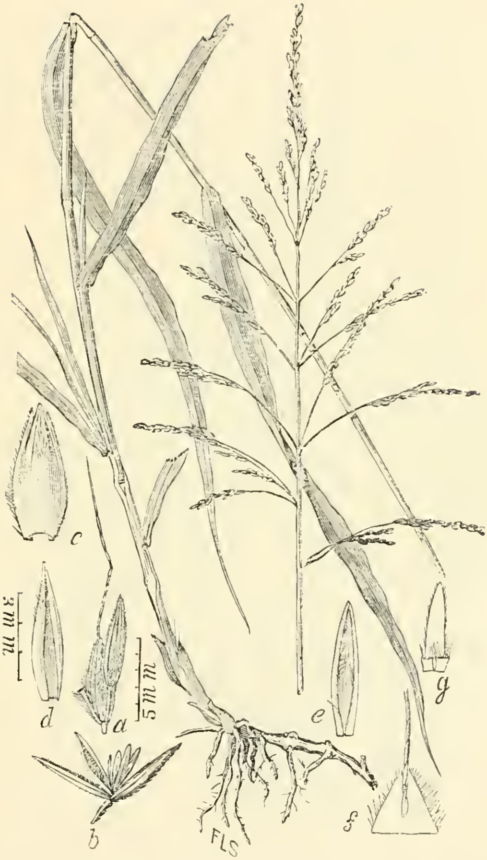

FIG. 321. **Andropogon halepensis** Brot. (*Sorghum halepense* Pers; *Holcus halepensis* Linn. Sp. Pl. Ed. 1, 1047.) JOHNSON GRASS.—A stout, smooth, erect perennial 1 to 2 m. high, from strong, creeping rootstocks, with long, flat leaves, 1 to 2 cm. broad, and open panicles 15 to 30 cm. long. Sessile spikelets (*a*) 4 to 5.5 mm. long, the awn of the flowering glume 10 to 15 mm. long.—Introduced and cultivated in many of the Southern States for hay. [Southern Europe, Asia, and North Africa.]

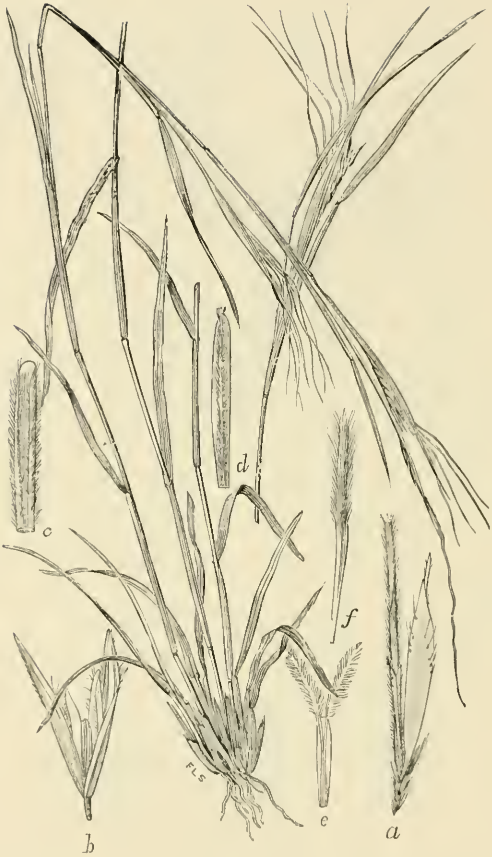

FIG. 322. **Andropogon contortus** Linn. Sp. Pl. ed. 1, 1045. TWISTED BEARD-GRASS.—A stout perennial 4 to 10 dm. high, with rather broad leaves and solitary, bearded racemes, terminating the culm or its branches. Racemes about 5 cm. long. Sessile spikelet 9 to 10 mm. long, pubescent. Awns twisted 8 to 10 cm. long.—Sandy soil, Texas to Arizona. [Tropical and subtropical countries of both hemispheres.] April–October.

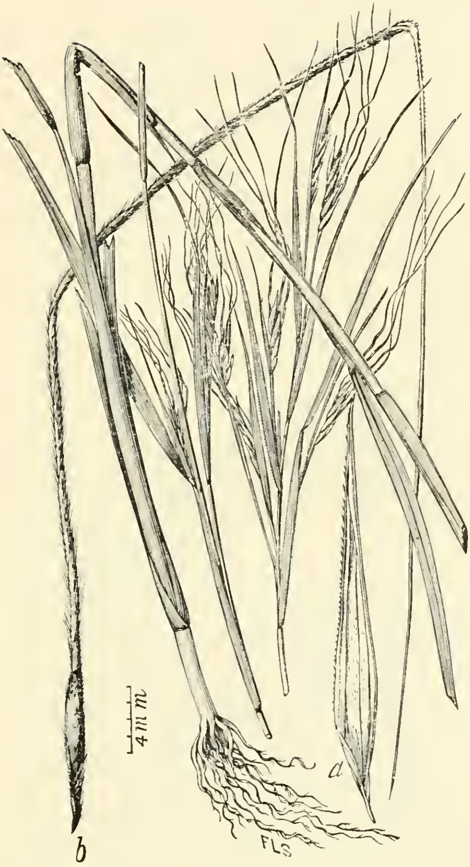

FIG. 323. **Andropogon melanocarpus** Ell. Sk. Bot. S. Car. & Ga., **1** : 146. 1817. (*Stipa melanocarpa* Muhl.) LARGE-FRUITED BEARD-GRASS.—A stout, branching annual with slightly compressed culms, 5 to 20 dm. high, leaves 15 to 40 cm. long, 0 5 to 1 cm. wide, and terminal or lateral racemes 4 to 6 cm. long. Sessile spikelet (*b*) 7 to 9 mm. long with a sharp barbate callus 3 mm. long, and a stout, densely villous awn 8 to 12 cm. long.—Fields and roadsides, Florida to Alabama. [Throughout the tropics.]

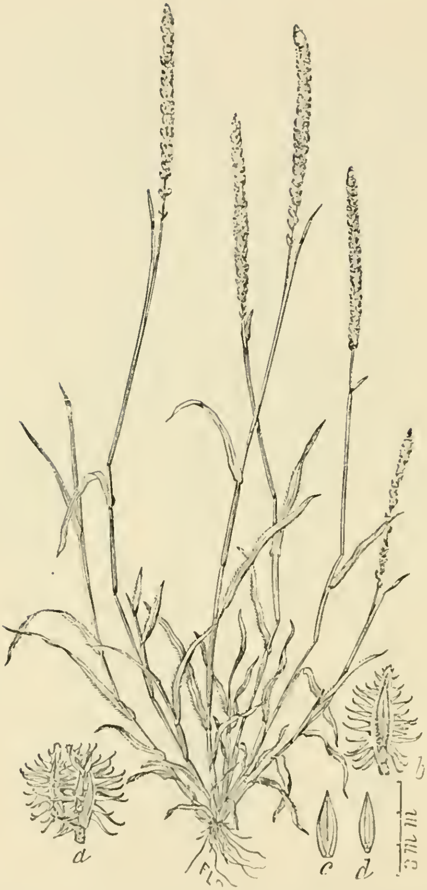

FIG. 324. **Nazia aliena** (Spreng.). (*Lappago aliena* Spreng. Neue Entd. **3**: 15. 1822. *Tragus occidentalis* Nees.; *Nazia racemosa aliena* Scribn. & Smith, Dept. Agr. Div. Agros. Bull. 1.) WESTERN PRICKLE-GRASS.—A rather slender and diffusely branching annual 1 to 3 dm. high, with spreading, flat leaves, slender spike-like racemes and hard spikelets, the second glume being covered with rigid hooked prickles.—Dry, rocky hillsides, Texas, New Mexico, and Arizona. [Mexico, West Indies, and South America.]

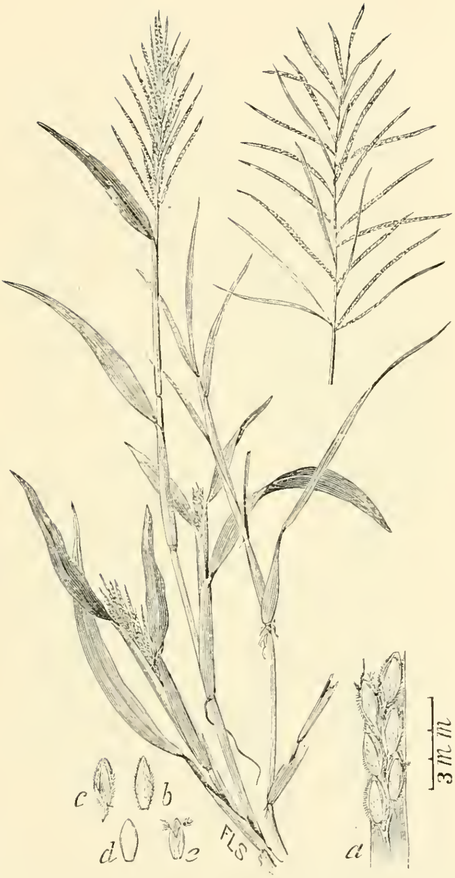

Fig. 325. **Paspalum mucronatum** Muhl. Cat. 8, 1813. (*P. fluitans* Kunth.) Floating Water-grass.—An aquatic with much branched, ascending culms from a creeping or floating base, 1.5 to 10 dm. long, and 10 to 50 slender racemes 2 to 6 cm. long. Spikelets in 2 series, subacute, 1.5 mm. long.—Southern Illinois to Florida, Louisiana, Indian Territory, and Texas. [Tropical America.] July–October.

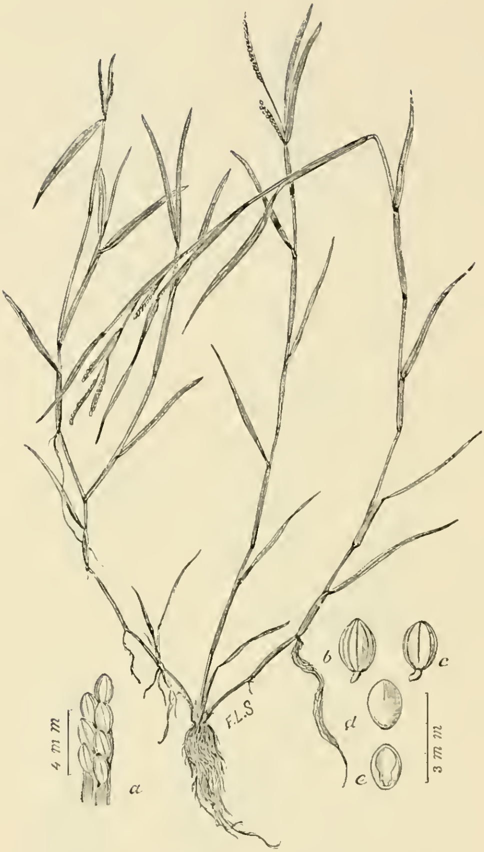

Fig. 326. **Paspalum membranaceum** Walt. Fl. Carol. 75. 1788. Not Lam. (*P. walterianum* Schultes.) WALTER'S PASPALUM.—A low, creeping, semiaquatic grass, with much branched, smooth stems 1.5 to 4.5 dm. long, short, flat leaves and 2 to 6 small racemes, 1 to 2 cm. long. Spikelets ovate, obtuse, about 2 mm. long, crowded in 2 rows on one side of the broad (2 to 3 mm.), flat rachis.—Wet soil, New Jersey and Delaware, south to Florida and westward to southern Ohio and Texas. [Cuba.] July–October.

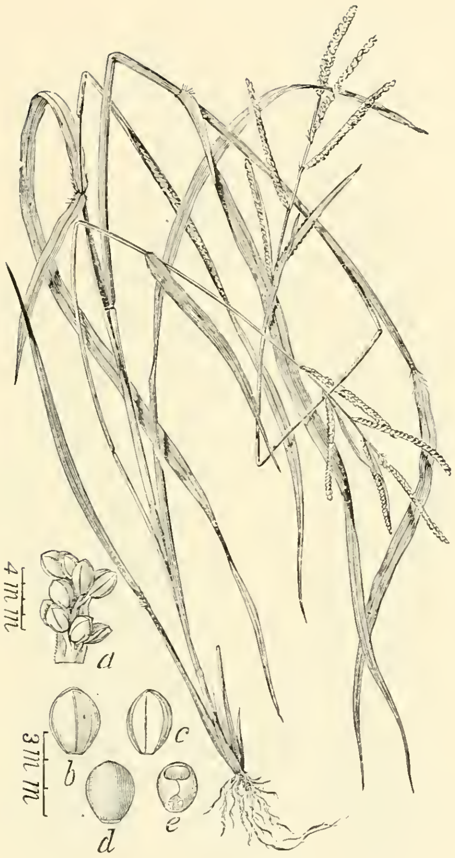

FIG. 327. **Paspalum boscianum** Flügge, Monog. 170. 1810. (*P. purpurascens* Ell.; *P. virgatum* Walt. not Linn.) PURPLE PASPALUM.—A stout perennial with ascending, branching culms 6 to 9 dm. high, long, flat leaves and numerous, usually purple-flowered racemes 2 to 6 cm. long, crowded near the summit of the culm or its branches. Spikelets glabrous, obovate, obtuse, 2 mm. long.—Low woodlands and along ditches, North Carolina and Tennessee to Florida westward to Mississippi and Louisiana. July–September.

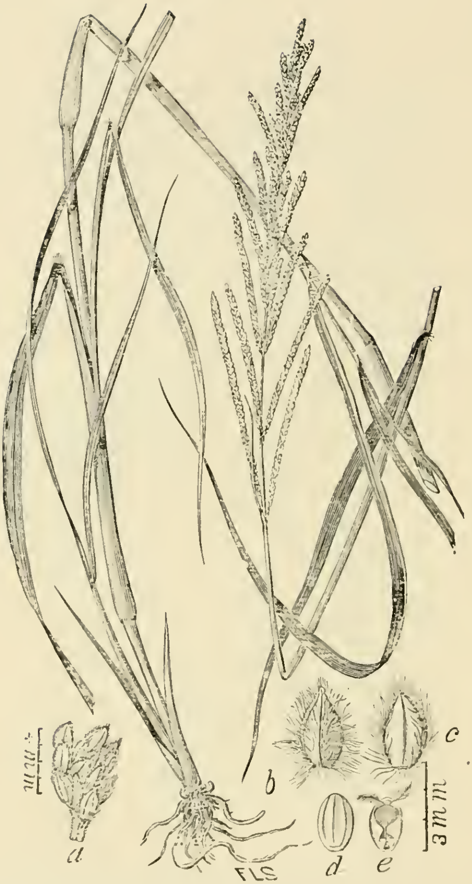

FIG. 328. **Paspalum vaseyanum** Scribn. n. sp. (*P. virgatum pubiflorum* Vasey, not *Paspalum pubiflorum* Rupr.) VASEY'S PASPALUM.—A rather stout, erect perennial 9 to 18 dm. high, with long, flat, glabrous leaves and 12 to 20 ascending racemes 5 to 10 cm. long. Spikelets ovate, 2 to 2.5 mm. long, the acute outer glumes long-hairy on the margins, the first thinly hairy all over.—Along ditches, roadsides, and in old fields, Louisiana to Texas. July–September.

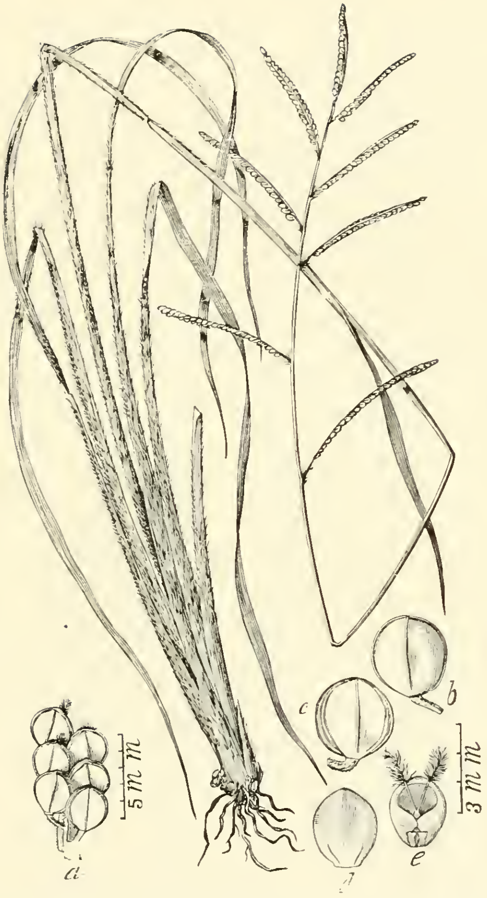

FIG. 329. **Paspalum curtissianum** Steud. Syn. Pl. Glum. **1** : 26. 1855. CURTISS' PASPALUM.—A coarse, erect perennial 9 to 17 dm. high with the lower sheaths usually densely villous, long, flat leaves, and 3 to 8 spikes 4 to 10 cm. long. Spikelets (*c*, *b*) nearly orbicular in their outline, strongly compressed on the back, about 3 mm. long.—Damp pine barrens, Florida to Mississippi. July, August. No. 4990, A. H. Curtiss. 1894, and 3865, S. M. Tracy.

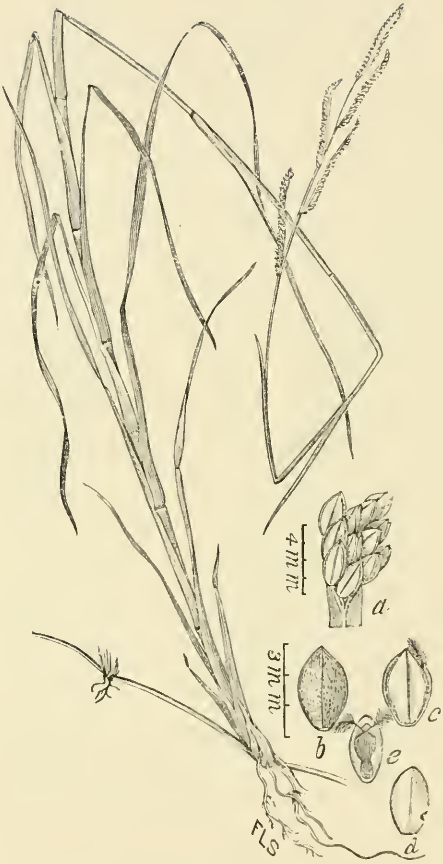

FIG. 330. **Paspalum lividum** Trin. MS. Schlecht in Linnaea, **26**: 383. 1853–55; Vasey, Bull. Torr. Bot. Club, **13**: 164; Contrib. U. S. Nat. Herb., **3**: 18.—A rather slender, cæspitose perennial with very sharp-pointed, usually erect leaves and 1 to 8 approximate, usually somewhat curved racemes 2 to 3 cm. long. Spikelets crowded, obovate, subacute, 2 to 3 mm. long.—Low grounds. Texas.

Plant often geniculate, more or less creeping at the base.

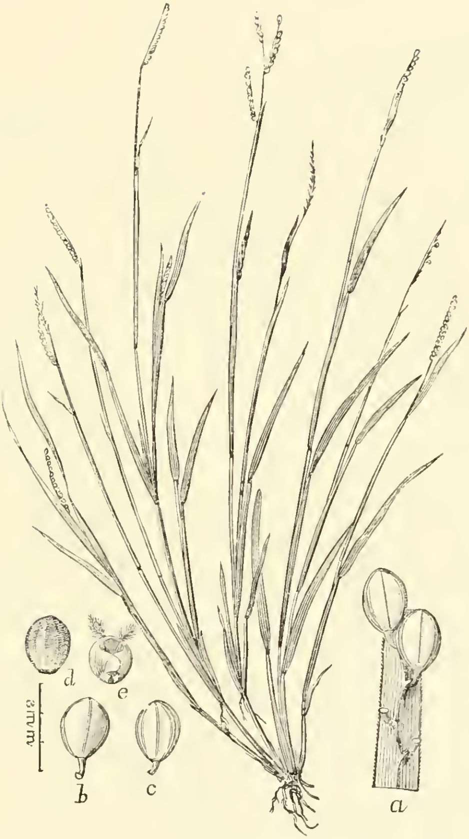

Fig. 331. **Paspalum scrobiculatum** Linn. Mant. **1**:29. 1767. Trin. Icon. Gram. t. 143. Ditch Millet.—A densely cæspitose perennial, 2 to 6 dm. high, with rather soft culms often geniculate at the lower joints; narrow, flat leaves and 2 to 5 racemes approximate near the summit of the culm or its branches, 2 to 4 cm. long. Spikelets (*b*, *c*) rounded, obtuse, 2 to 3 mm. long.—Wet places, Florida (No. 5760, Curtiss, 1896). [Tropical countries of both hemispheres.] August, September.

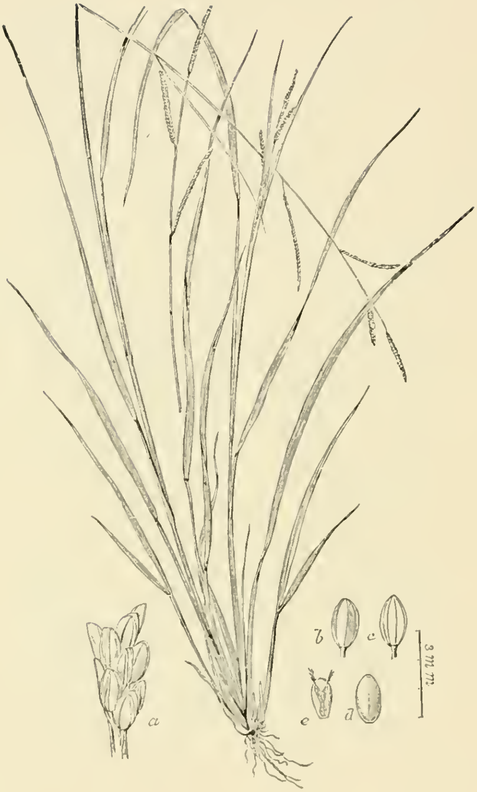

Fig. 332. **Paspalum blodgettii,** Chapm. Flor. So. U. S. 571.—A slender, densely cæspitose, erect perennial, 4 to 10 dm. high, with flat, glabrous, thin leaves and slender racemes 2 to 4 cm. long. Spikelets (*b, c*) elliptical-oblong, obtuse, about 1.7 mm. long, with the 3 nerved outer glumes thinly and minutely pubescent. Florida.

Very variable as to the length of leaves.

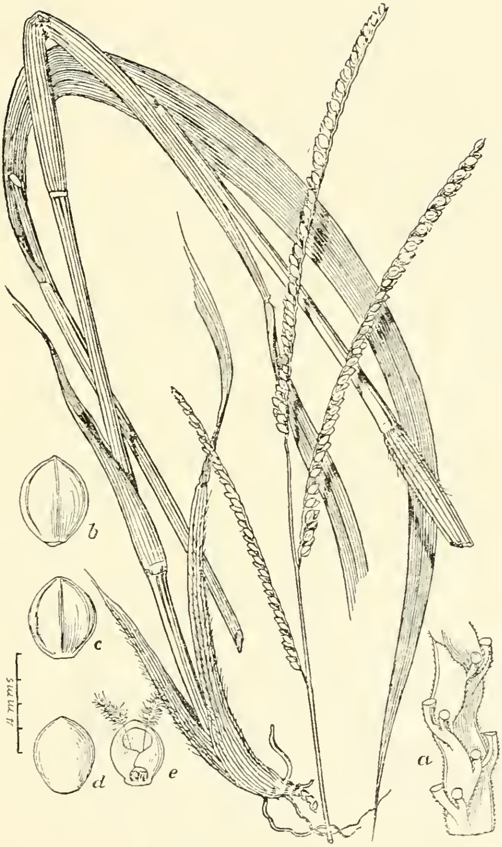

Fig. 333. **Paspalum giganteum** Vasey, Descrip. Cat. 6; Bull. Torr. Bot. Club, **13** : 166. 1886. GIANT WATER-GRASS.—A stout, erect perennial, 8 to 16 dm. high, with broad (often 2 to 3 cm.), flat leaves, and 2 to 5 racemes, 15 to 25 cm. long. Spikelets (*b, c*) crowded, plano-convex, obtuse, about 3 mm. long.—Moist grounds and ditches, Florida. June–August.

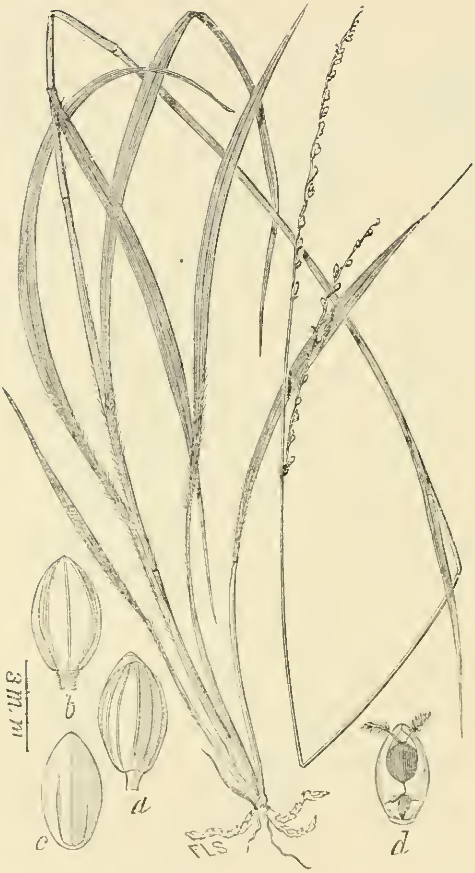

FIG. 331. **Paspalum bifidum** (A. Bertol.) Nash. 1897. (*Paspalum racemulosum* Chapm.) LOOSELY-FLOWERED PASPALUM.—A slender, erect perennial 6 to 12 dm. high, long, flat leaves, villous sheaths, at least the lower ones, and slender, rather remotely flowered racemes 5 to 12 cm. long. Spikelets (*a, b*) on comparatively long pedicels, obovate, obtuse, about 3 mm. long.—Dry, sandy soil, pine barrens of Alabama and Florida westward to Louisiana and Texas. August–October.

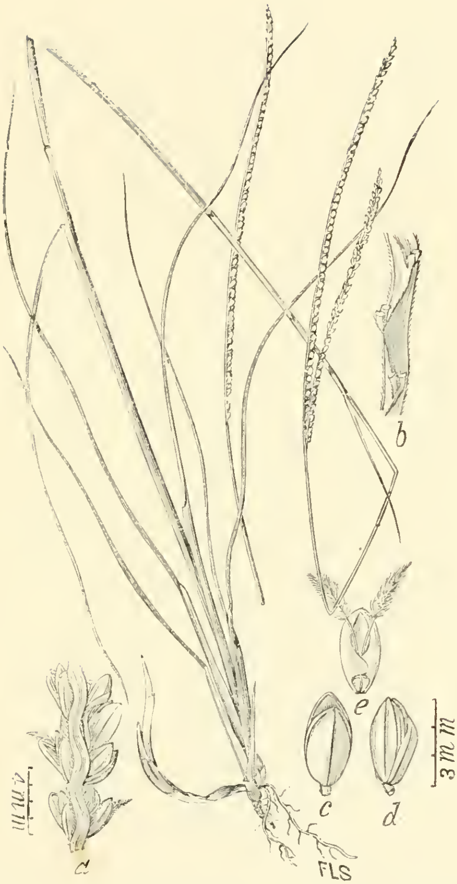

Fig. 335. **Paspalum monostachyum** Vasey in Chapm. Fl. S. States, Suppl. 665; Bull. Torr. Bot. Club, **13** : 163. 1886. A rigid, erect perennial 6 to 10 dm. high, from a creeping rootstock, with very long, narrow, involute leaves, the lower ones often 3 to 6 dm. long, and one (rarely two) terminal raceme 15 to 20 cm. long. Spikelets crowded, oblong, obtuse, 3 mm. long.—Low grounds, Florida to Texas.

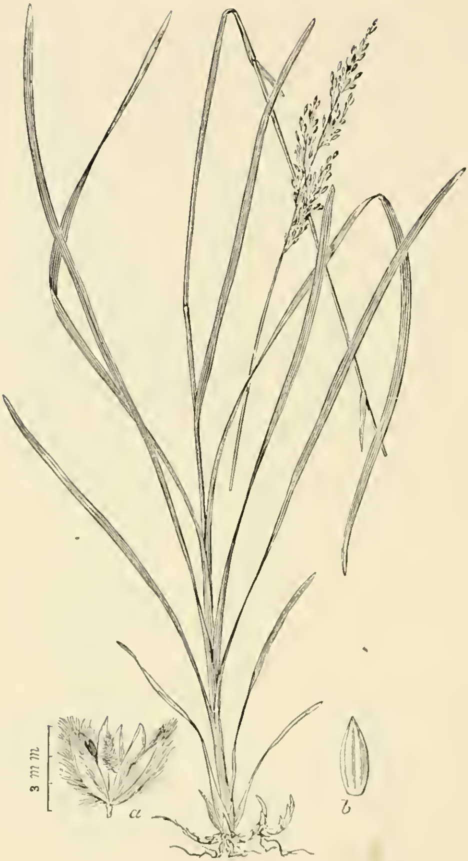

FIG. 336. **Anthenantia rufa** (Ell.) Schultes, Mant. **2**: 258. (*Aulaxanthus rufus* Ell. Bot.: 103. *Panicum rufum* Kunth.) RED-HAIRED ANTHENANTIA.—A slender, erect, glabrous and rather rigid perennial 3 to 8 dm. high, from creeping rootstocks, with narrow, green, or often rufous, rather loosely flowered panicle 8 to 15 cm. long. Spikelets (*a*) 3 mm. long, villous, with spreading hairs on the outer glumes.—Moist, sandy soil, pine barrens, North Carolina to Florida and westward to Texas. August–October.

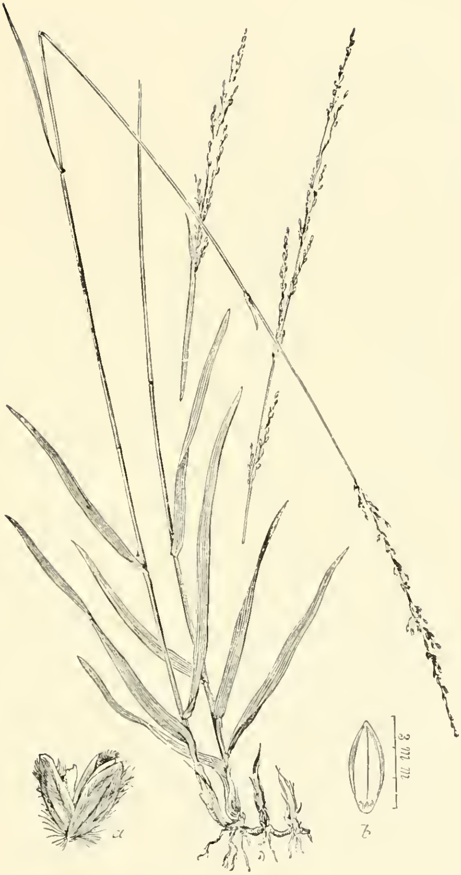

FIG. 337. **Anthenantia villosa** (Michx.) Benth. (*Phalaris villosa* Michx. Fl. **1**: 43. 1803. *Panicum ignoratum* Kunth.)—An erect, somewhat wiry perennial, 6 to 12 dm. high, from strong, creeping rootstocks, with flat, rather short leaves, and loosely flowered panicles, 10 to 20 cm. long. Spikelets (*a*) about 3 mm. long, outer glumes villous with spreading hairs.—Dry sandy soil, in open pine barrens, etc., South Carolina to Florida and westward to Louisiana and Texas. July-October.

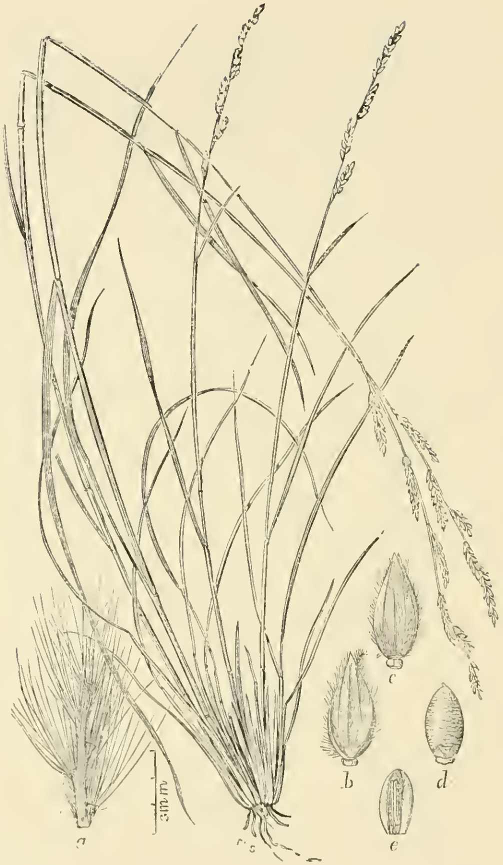

FIG. 338. **Eriochloa sericea** Munro, MS.; Vasey Contrib. U. S. Natl. Herb., **3**: 21, and Ill. N. Am. Grasses, Part I, t. 1. SILKY EVERLASTING-GRASS.—A slender, erect, tufted perennial 3 to 10 dm. high, with numerous basal leaves and slender, simple, racemose panicles. Spikelets (*b* and *c*) elliptical-oblong, acute, 3 to 4 mm. long, imbricate in two rows along one side of the flat rachis: outer glumes silky-villous. Pedicels bearing hairs as long as the spikelets.—Dry soils, Texas to Arizona. September.

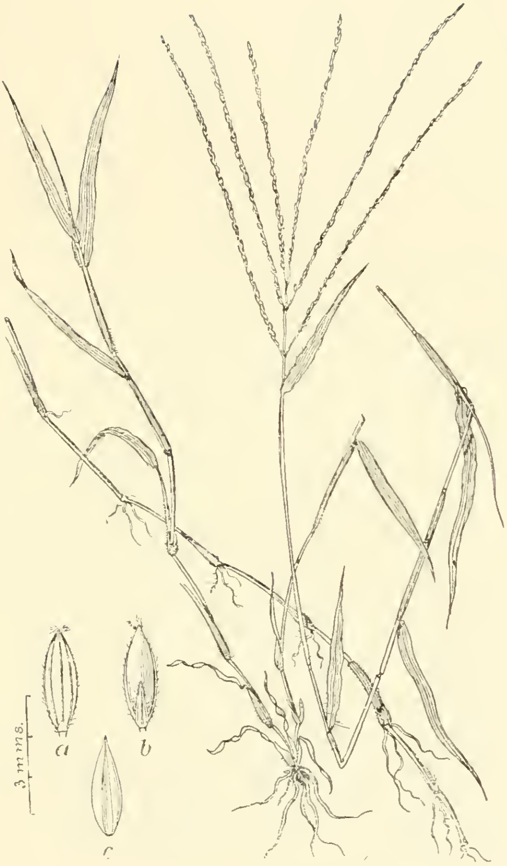

Fig. 339. **Panicum sanguinale** Linn. Sp. Pl. 84. 1753. (*Digitaria sanguinalis* Scop.; *Syntherisma præcox* Walt.) Crab-grass.—A much-branched, leafy annual, more or less decumbent and rooting at the lower nodes. Stems 3 to 9 or 12 dm. long, nodes and sheaths usually hairy. Spikelets 2.5 to 3 mm. long, in digitate or subfasciculate racemes, which are 5 to 18 cm. long.—A weed in cultivated fields and lawns. [Warmer temperate regions of both hemispheres.] June–September.

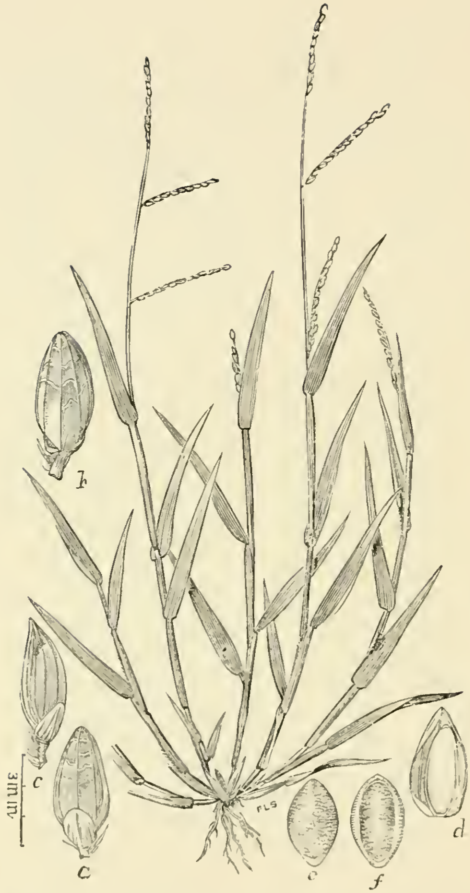

Fig. 310. **Panicum platyphyllum** Munro, ex Wright in Sauv. Fl. Cub. 197, without description; Vasey in Contrib. U. S. Natl. Herb., **3**:27. Flat-leafed Panic-grass.—A much-branched, ascending, leafy perennial, rooting at the lower joints; flowering stems 3 to 5 dm. high. Spikelets (*a*, *b*, *c*) broadly ovate, oblong, obtuse, about 4 mm. long, arranged in slender, spike-like racemes, which are approximate near the apex of the culm or its branches.—Low grounds, Texas. [Cuba.] June, July.

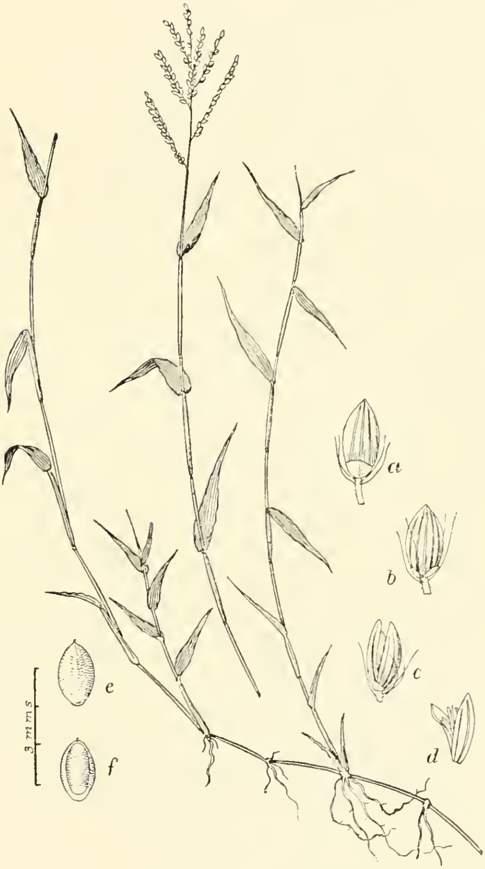

FIG. 341. **Panicum prostratum** Linn., Sp. Pl. 87; Chapm. Fl. S. States, Suppl. 666. LOW PANIC-GRASS.—A slender, creeping, and much-branched perennial, with short, ciliate leaves and terminal panicles composed of 5 to 10 simple racemes. Spikelets (*a*, *b*, *c*) ovate-oblong, glabrous, about 2 mm. long.—Moist or wet grounds, New Jersey (ballast), Alabama to Florida, and westward to Louisiana and eastern Texas. [Tropical countries of both hemispheres.] September.

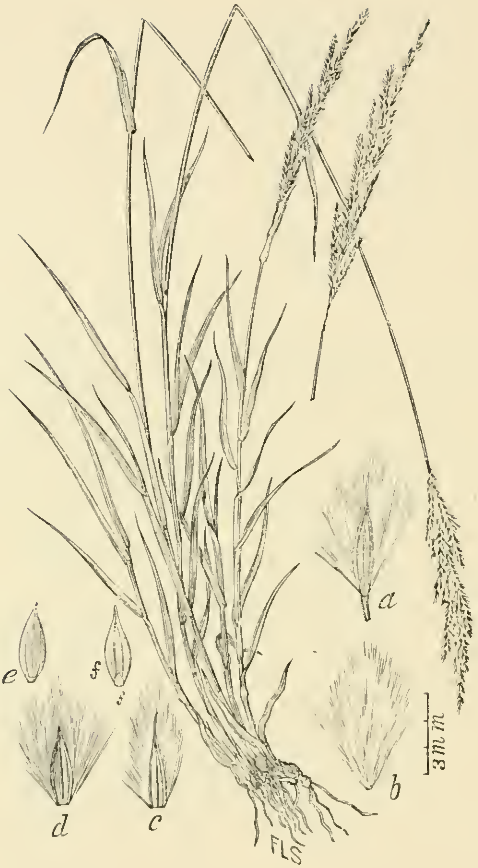

Fig. 342. **Panicum saccharatum** Buckl. Prel. Rep. Geol. and Agr. Surv. Tex. 2. 1866. (*P. lachnanthum* Torr., 1857, not Hochst. 1855). Arizona Cotton-grass.—A leafy, erect perennial, 3 to 9 dm. high, usually much-branched below; culms terminated by narrow panicles 10 to 20 cm. long. Spikelets (*a*, *b*) about 3 mm. long, densely silky-villous, the spreading hairs nearly 3 to 4 mm. long.—Dry hillsides, canyons, etc., southern Colorado, Texas, New Mexico, and Arizona.

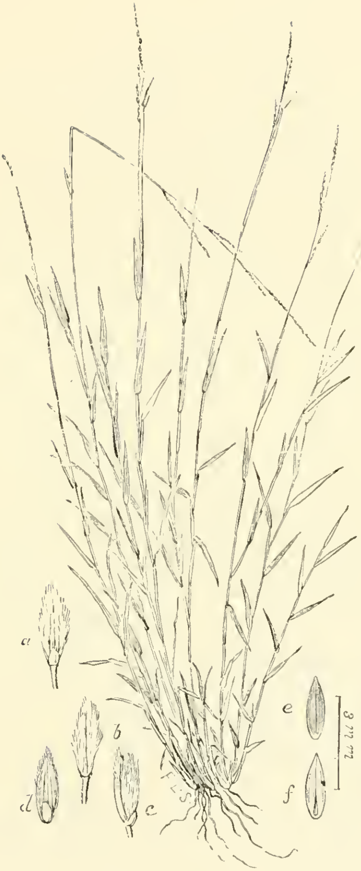

FIG. 343. **Panicum tenerrimum** (Nees) Kunth, Gram. **1** : 39. (*Trichachne tenuis* Nees.) SLENDER WOOLLY PANIC.—A slender, erect, branching, and leafy perennial (?) 2 to 5 dm. high, with short and rather rigid flat leaves, and simple panicles about 10 cm. long. Spikelets (*a*, *b*, *c*) 2 mm. long; the first glume glabrous; the second and third glumes densely clothed with short, silky hairs.—Low grounds, Texas (Pecos County); rare. September, October.

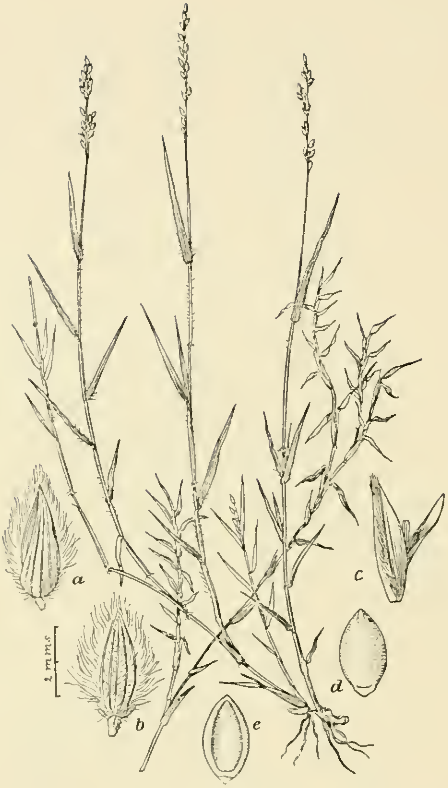

FIG. 314. **Panicum ciliatissimum** Buckl. Buckl. Prel. Rep. Geol. and Agr. Surv. Tex. 4. 1866. Vasey, U. S. Dept. Agr., Div. Bot., Bull. **8**:28. 1889. INDIAN WHEAT. CARPET GRASS.—A creeping, much branched, leafy perennial with upright flowering stems 1 to 3 dm. high and narrow few-flowered panicles 2 to 4 cm. long. Spikelets (*a*, *b*) about 3.5 to 4 mm. long, with the second and third glumes densely ciliate-hairy near the margins.—Low grounds, southern Texas. May.

This grass is locally known as carpet grass. The extensively creeping, short-jointed, and leafy stems of this grass suggest a close resemblance to Bermuda grass.

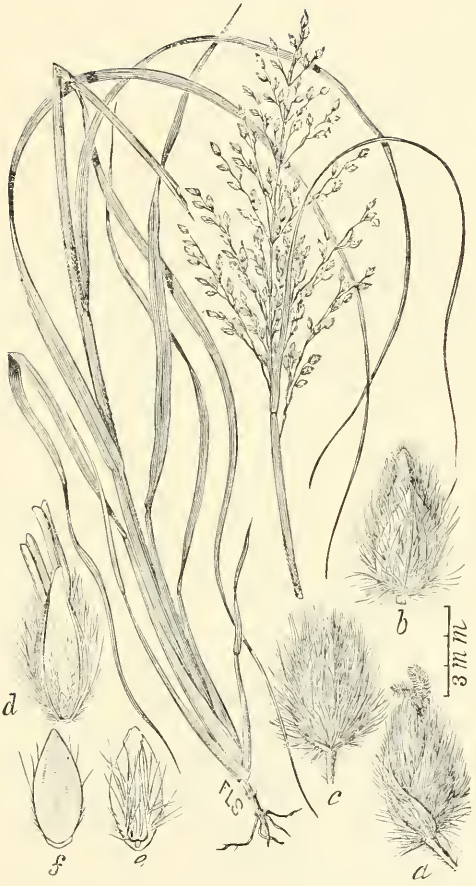

Fig. 345. **Panicum urvilleanum** Kunth, Revis. Gram., **1** : 35 et **2** : tab. 115. Woolly-flowered Panic.—A stout, erect perennial 3 to 5 dm. high, with long, flat leaves and open panicles 15 to 25 cm. long. Spikelets (*a*, *b*, *c*) 4 to 6 mm. long, ovate, the outer glumes clothed with rather long hairs. Whole plant more or less hairy.—Sandy soil, southern California. [South America.] March–June.

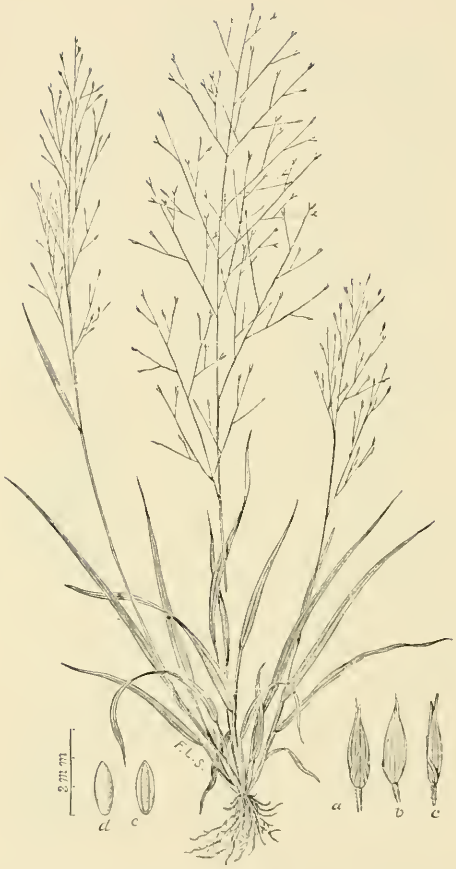

Fig. 346. **Panicum flexile** (Gattinger) Scribn. Bull. Torr. Bot. Club. **20**: 476. 1893. (*P. capillare var. flexile* Gattinger, Tenn. Fl. 94. 1887.) Wiry Panic grass.—A rather slender, erect annual, 3 to 6 dm. high, branching at the base, with flat leaves, capillary panicles, and rather distant, acute spikelets (*a*, *b*, *c*), 3 mm. long. In both moist and dry sandy soils, Pennsylvania and Michigan, southward to Florida and Mississippi. July–October.

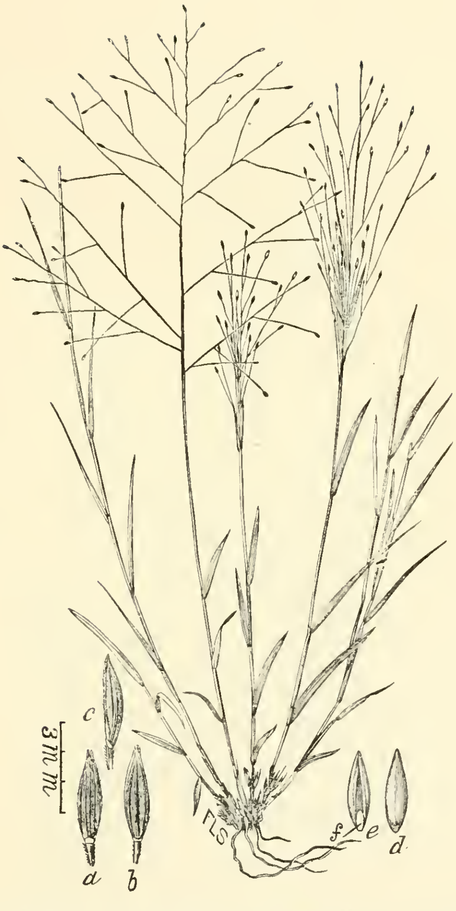

FIG. 347. **Panicum cognatum** Schultes, Mant. **2**: 235. 1824. (*P. divergens* Muhl. 1817, not H. B. K. 1815; *P. autumnale* Bosc. 1825.) FALL WITCH-GRASS.—A slender, erect, or ascending perennial, usually much branched at the base, 3 to 6 dm. high, with rather short, narrow leaves, diffusely branching panicles, and acute, lanceolate spikelets (*a, b, c*) about 3 mm. long.—Dry soil, South Carolina and Florida to Illinois, Minnesota, Kansas, and Arizona. June–October.

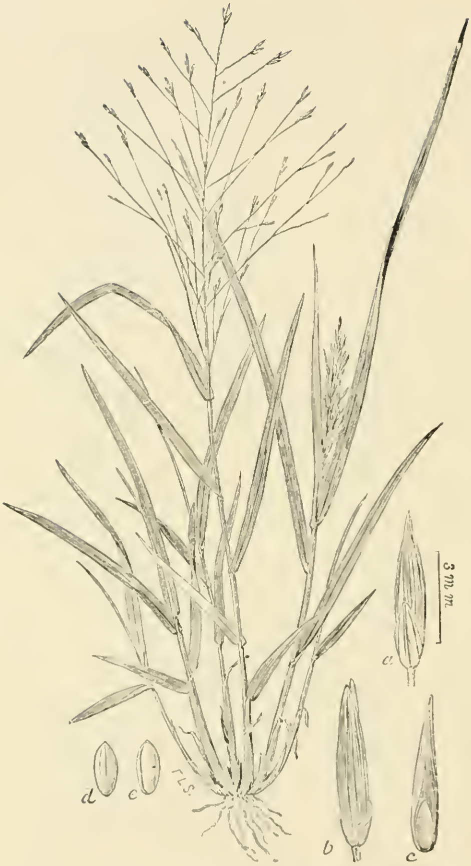

FIG. 318. **Panicum capillarioides** Vasey, Contr. U. S. Nat. Herb. **1**: 51. 1890. TEXAS WITCH-GRASS.—An erect, more or less branching perennial, 2.5 to 5 dm. tall, with narrow and more or less elongated, flat leaves and diffuse panicles 15 cm. long. Spikelets (*a*, *b*) narrowly lanceolate, acute, 5 to 6 mm. long.—San Diego and Pt. Isabel, Texas. May.

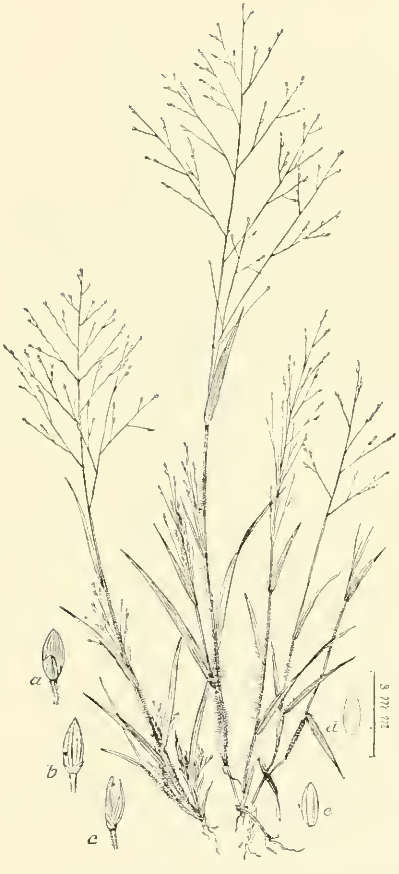

FIG. 349. **Panicum minus** Nash, Bull. Torr. Bot. Club, **22**: 421. *P. capillare* var *minimum* Scribn. Bull. Tenn. Agr. Exp. Sta. **7**: 44, fig. 39). SMALL WITCH-GRASS.—A slender annual, rarely more than 3 dm. high, with long-pilose sheaths, narrow, flat leaves and oval or pyramidal, few-flowered panicles 8 to 16 cm. long. Spikelets (*a*, *b*, *c*) about 1.5 mm. long.—Dry, open woodlands and thickets, New Brunswick southward to Georgia and westward to Wisconsin and Alabama. August, September.

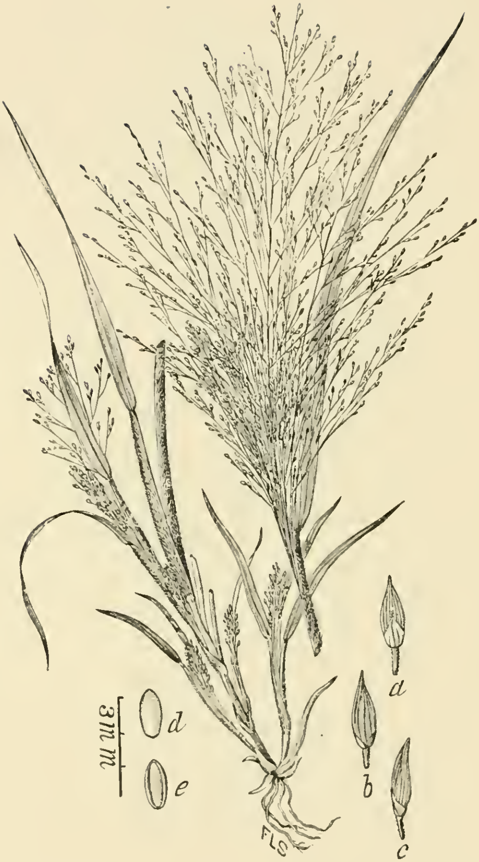

Fig. 350. **Panicum capillare** Linn. Sp. Pl. 86. Old Witch-grass or Fool Hay.—An annual with usually coarse, branching stems 3 to 9 dm. high, hairy or hirsute sheaths, and widely spreading capillary panicles 6 to 24 cm. long. Spikelets (*a, b, c*) acute, smooth, about 2 mm. long.—A weed in cultivated fields, specially in sandy soils. Maine and Nova Scotia to British Columbia, southward to Florida and Texas. [Europe.] July-October.

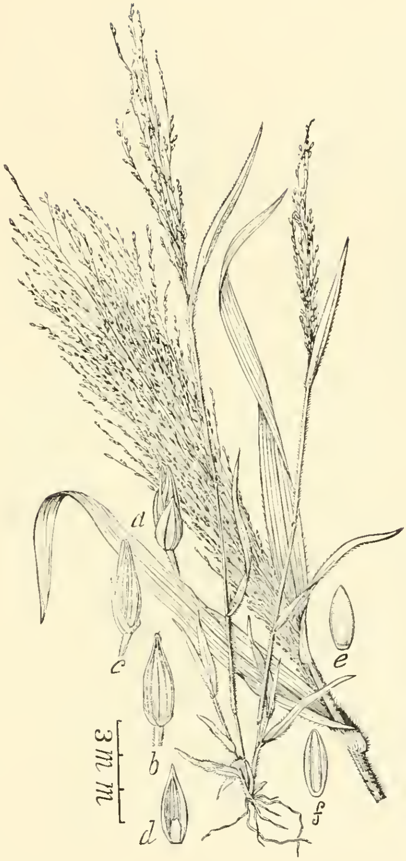

FIG. 351. **Panicum hirticaulum** J. S. Presl in Rel. Haenk. **1**: 308. 1830. ROUGH PANIC-GRASS.—A slender, or occasionally rather stout, erect perennial, often geniculate at the lower nodes, with papillate-pilose sheaths, flat and usually glabrous leaves and terminal, more or less spreading, many-flowered panicles. Spikelets (*a*, *b*, *c*) lanceolate, acute, about 3 mm. long, glabrous.—Texas, New Mexico, and Arizona to Washington. [Mexico, Galapagos Islands]. August, September.

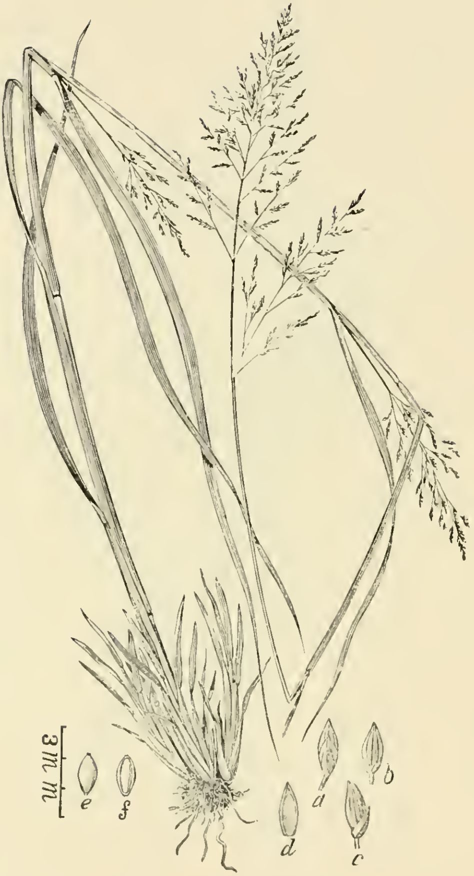

FIG. 352. **Panicum elongatum** Pursh, Flor. Am. Sept., 69. 1814. (*Panicum agrostoides* Muhl. 1817.) MUNRO-GRASS.—A stout, erect, glabrous, and branching perennial 9 to 15 dm. high, with long, flat leaves, and pyramidal panicles terminating the culm and its branches. Spikelets (*a*, *b*, *c*) very acute, about 2.5 mm. long, crowded.—Wet meadows and along the banks of streams, New Jersey to North Carolina and Kentucky. August, September.

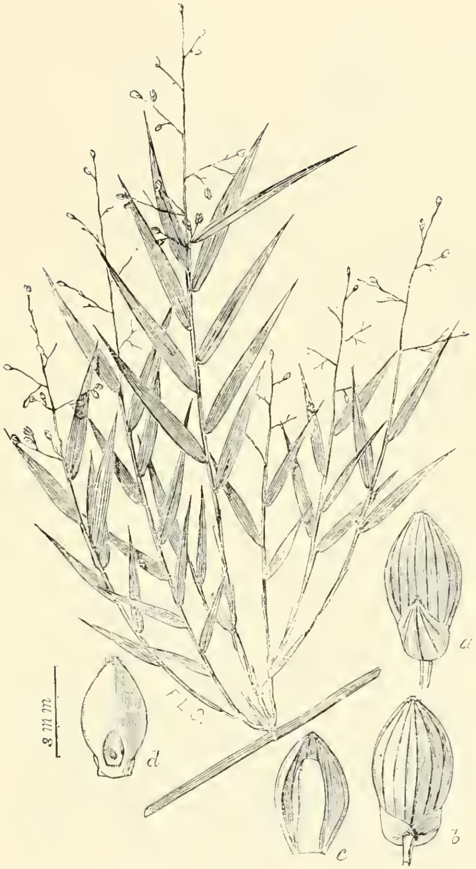

FIG. 353. **Panicum divaricatum** Linn. Am. Acad., **5**: 302. (*P. latifolium* Linn. Sp. Pl. in part.) SMALL CANE.—A coarse, woody, bamboo-like perennial, reclining or climbing over bushes, with usually numerous, short and spreading, flower-bearing branches at the nodes. Leaves lanceolate-acute; panicles simple, few-flowered. Spikelets (*a*, *b*) swollen, about 4 mm. long. Glumes tipped with a tuft of hairs.—Dry woods and thickets, southern Florida [West Indies, Mexico, and tropical America]. March–September.

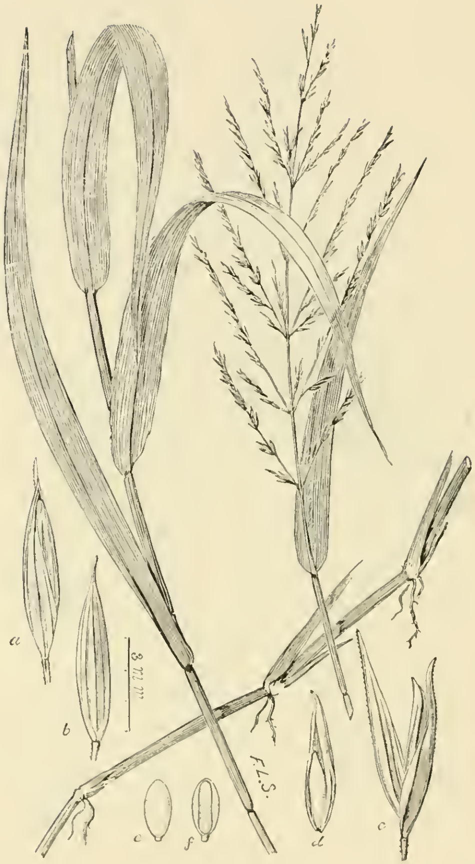

Fig. 354. **Panicum gymnocarpon** Ell. Bot. S. C. and Ga., **1**: 117. Chapm. Flor. S. U. S. 573. Marsh Panic-grass.—A fibrous-rooted, smooth perennial with geniculate, ascending stems 6 to 12 dm. high, with long and rather broad, flat leaves and simple terminal panicles about 30 cm. long. Spikelets (*a*, *b*) lanceolate-acute, about 6 mm. long, arranged along one side of the panicle-branches. Outer glumes much longer than the flowering one.—Low grounds, Georgia and Florida westward to Louisiana and Texas. July-September.

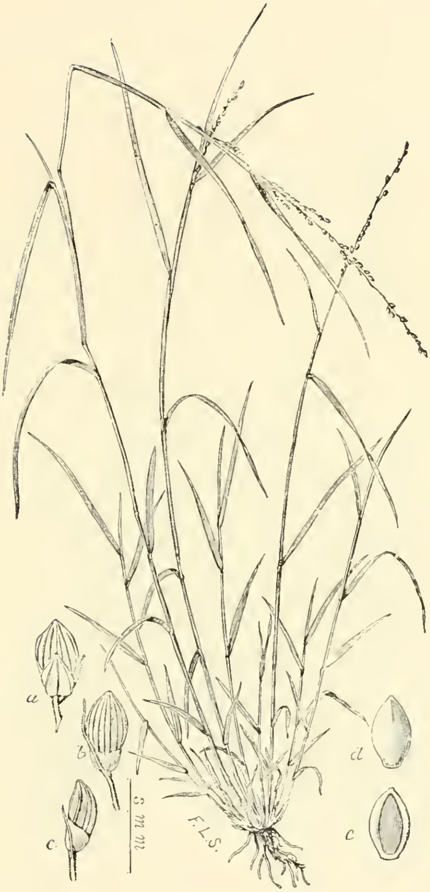

Fig. 355. **Panicum subspicatum** Vasey, U. S. Dept. Agr. Div. Bot., Bull. **8**: 25. 1889. Narrow-topped Panic.—A slender, erect, more or less branching, leafy perennial, 2 to 4 dm. high, with flat, more or less spreading leaves and narrow, nearly simple, terminal panicles, the ultimate branches terminating in a short bristle. Spikelets (*a*, *b*, *c*) about 2.2 mm. long.—Dry, sandy plains, southern Texas. August.

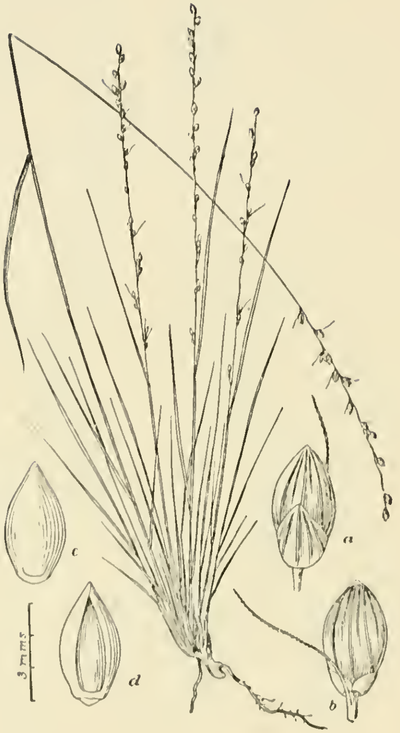

FIG. 356. **Panicum reverchoni** Vasey, U. S. Dept. Agr. Div. Bot., Bull. 8 : 25. 1889. REVERCHON'S PANIC.—A slender, erect, and rather densely caespitose perennial with very narrow, erect leaves and terminal, simple panicles, the appressed branches terminating in short bristles. Spikelets (*a*, *b*) 3.5 to 4 mm. long.—Sandy plains, Texas. June-September.

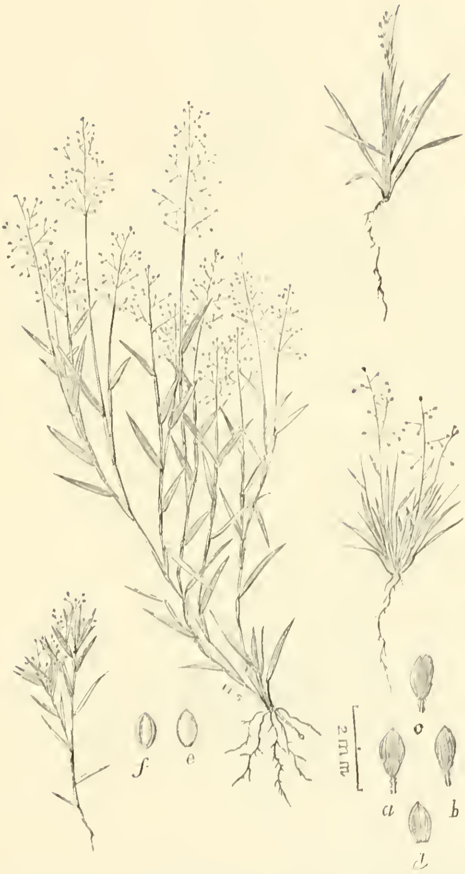

FIG. 357. **Panicum wrightianum** Scribn., U. S. Dept. Agr. Div. Agros. Bull. **11**: 41.—A slender, much branched, leafy perennial, with smooth, delicate panicles 2 to 3 cm. long, and small (hardly 1 mm. long) spikelets (*a*, *b*, *c*), the second and third glumes of which are minutely and densely pubescent. Leaves 1 to 3 cm. long, 2 to 3 mm. wide, minutely pubescent on the under side.—Moist, sandy soil in open pine woodlands, Florida. [Cuba]. July–October.

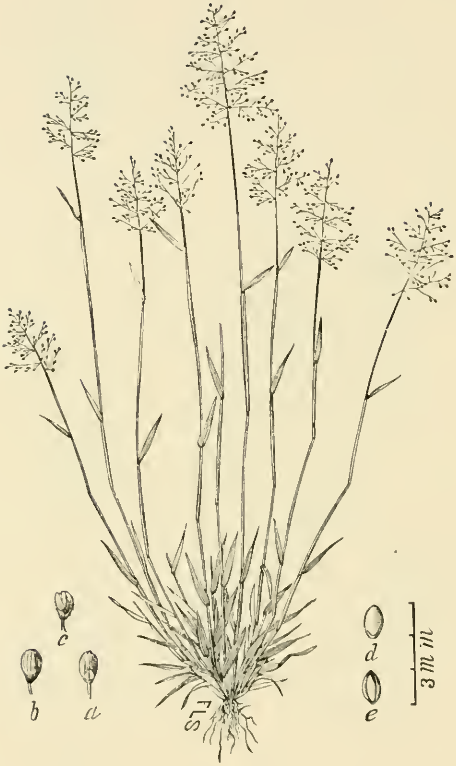

FIG. 358. **Panicum baldwinii** Scribn. U. S. Dept. Agr. Div. Agros. Bull. **11** : 43. (*Panicum nitidum* var. *minor* Vasey; *P. dichotomum* var. *nitidum* Chapm.).—A densely cæspitose, slender, glabrous perennial, 1 to 3 dm. high, with short, narrow, and more or less spreading leaves, ovoid or pyramidal panicles 2 to 4 cm. long, and glabrous, ovoid, or pear-shaped spikelets (*a*, *b*, *c*) about 1 mm. long.—Rather dry, sandy soil, Georgia and Florida to Mississippi. March–August.

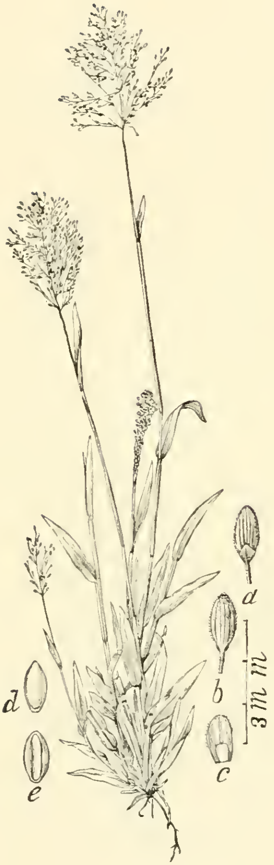

FIG. 359. **Panicum albomarginatum** Nash, Bull. Torr. Bot. Club, **24** : 40, 1897.—A slender, erect, glabrous, cæspitose perennial, 1.5 to 4.5 dm. high, with short sheaths, comparatively firm, erect leaves 1.5 to 4.5 cm. long, bordered with a conspicuous, serrulate, white margin. Panicles ovate, 2.5 to 4 cm. long, with many obovate, obtuse, minutely pubescent spikelets (*a*, *b*) 1.5 mm. long.—Low pine woodlands and swamps, Pennsylvania and Delaware to Florida and westward to Texas. April-October.

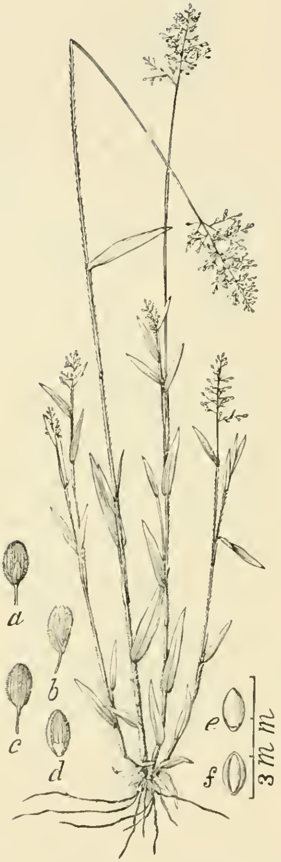

Fig. 360. **Panicum leucothrix** Nash. Bull. Torr. Bot. Club, **24**: 41. 1897.—A slender, erect, or ascending, sparingly branched perennial, 1 to 4.5 dm. high, with short, erect leaves 2 to 6 cm. long, and ovate or oval panicles 2.5 to 6 cm. long. Spikelets (*a*, *b*, *c*) obovate about 0.65 mm. long. Sheaths pubescent, with ascending or closely appressed, long, white hairs.—Sandy soil in low pine barrens and cypress swamps, southern Florida. April–July.

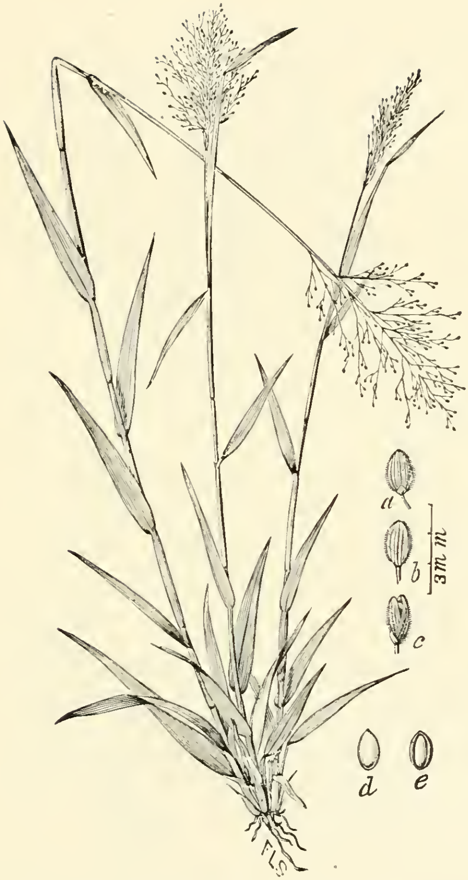

FIG. 361. **Panicum erectifolium** Nash, Bull. Torr. Bot. Club, **23**: 148. 1896. (*P. sphærocarpon floridanum* Vasey not *P. Floridanum* Trin.)—A rather stout, glabrous perennial, 4 to 6 dm. high, with erect and rather rigid leaves, and terminal, finally exserted, many-flowered, ovate or oblong panicles, 7 to 12 cm. long. Spikelets (*a*, *b*, *c*) about 1.5 mm. long, the second and third glumes minutely pubescent.—Swamps, Florida. March–July.

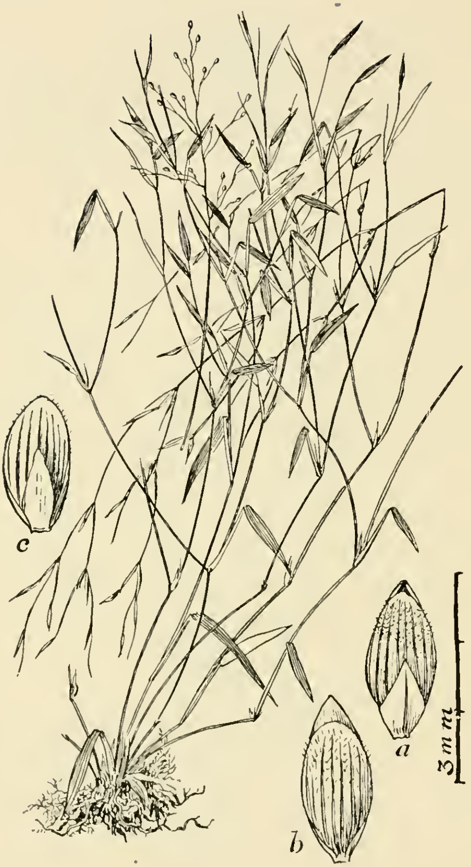

FIG. 362. **Panicum sphagnicolum** Nash, Bull. Torr. Bot. Club, **22** : 422. 1895.—A very slender, ascending or reclining perennial, 4 to 10 dm. high, at first simple, finally becoming much branched, with spreading, smooth leaves 4 to 8 cm. long, and small spreading panicles 4 to 5 cm. long. Spikelets (*a, b, c*) 2.5 to 3 mm. long, with the second and third glumes minutely pubescent, at least near the apex.—Low, boggy places, chiefly in thickets and stagnant swamps, Florida. June–October.

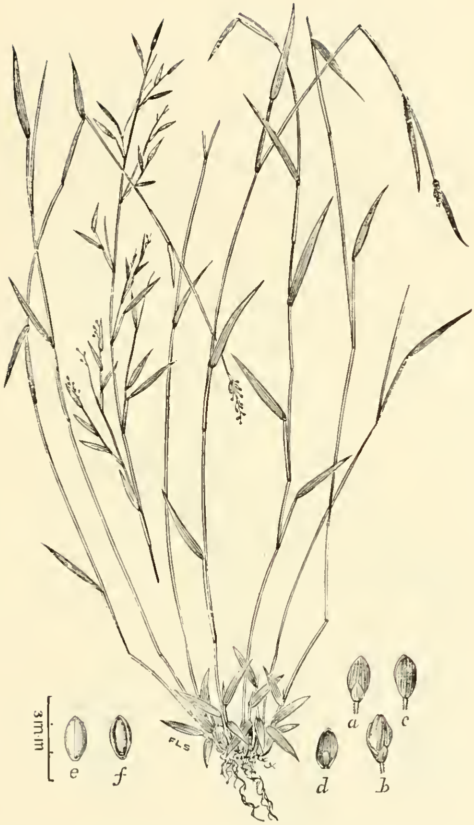

Fig. 363. **Panicum lucidum** Ashe, Journ. E. Mitch. Sci. Soc. **15**: 47. 1898. (*P. ramulosum* Mchx. ?.) A very slender, erect, or reclining, glabrous perennial 3 to 10 dm. high, with rather short (2 to 5 cm.), flat, acute leaves, and small, spreading panicles, 2 to 6 cm. long. Spikelets elliptical-ovate, obtuse, 1.8 mm. long, with the second and third glumes glabrous.—Low woods, New Jersey southward and westward to Texas, common.

Distinguished from *P. sphagnicolum* by its smaller and glabrous spikelets.

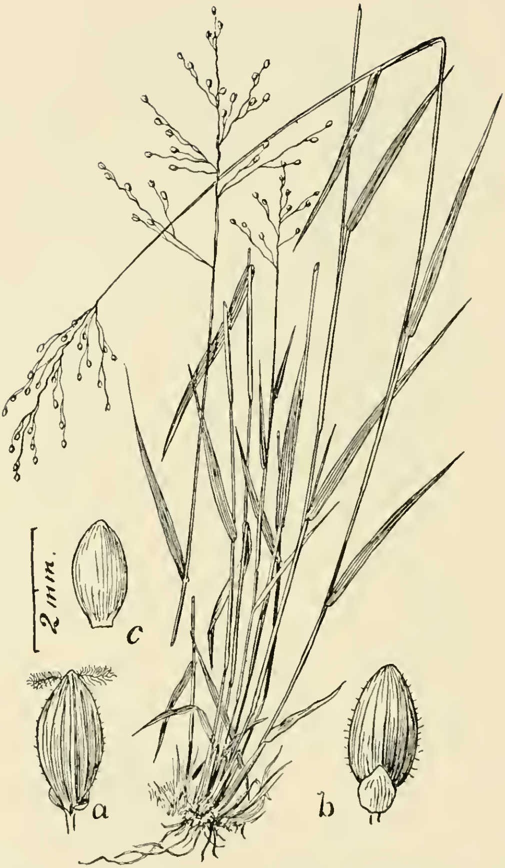

FIG. 364. **Panicum werneri** Scribn. in Britt. & Brown, Ill. Flor. **3**:501. 1898.—A slender, erect, glabrous perennial with erect, nearly linear, very acute leaves 5 to 8 cm. long, and open, ovoid or pyramidal panicles 5 to 8 cm. long. Branches of the panicle flexuous. Spikelets obovate or oblong, obtuse, about 2.2 mm. long, the obtuse second and third glumes glabrous or sparsely and minutely pubescent. Ohio.

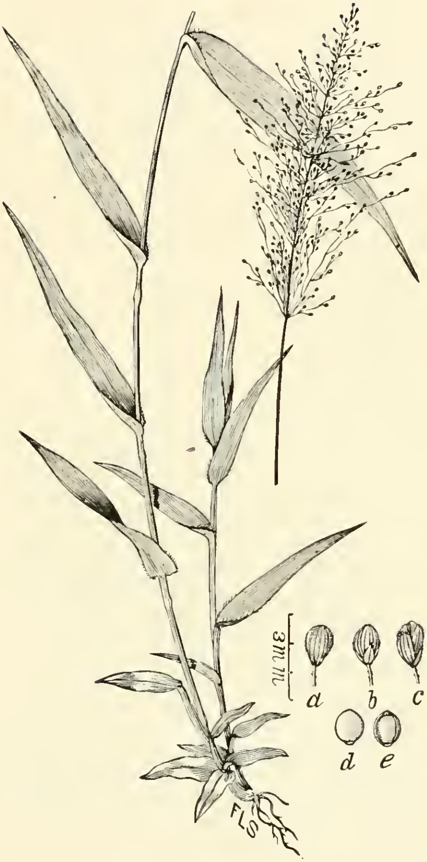

FIG. 365. **Panicum polyanthes** Schultes, Mant., **2** : 257. 1824. (*P. multiflorum* Ell. 1817, not Poir 1816; *P. microcarpon* Muhl. June, 1817, not ex Elliott Jan., 1817).—A rather stout, erect, and finally sparingly branched, smooth perennial, 3 to 8 dm. high, with broad, spreading leaves, many-flowered panicles, 7 to 18 cm. long, and minutely pubescent, nearly spherical spikelets (*a*, *b*, *c*) about 1.5 mm. long.—Dry open woodlands and occasionally in open grounds, New York southward to Florida and westward to Michigan, Nebraska, and Texas. June–October.

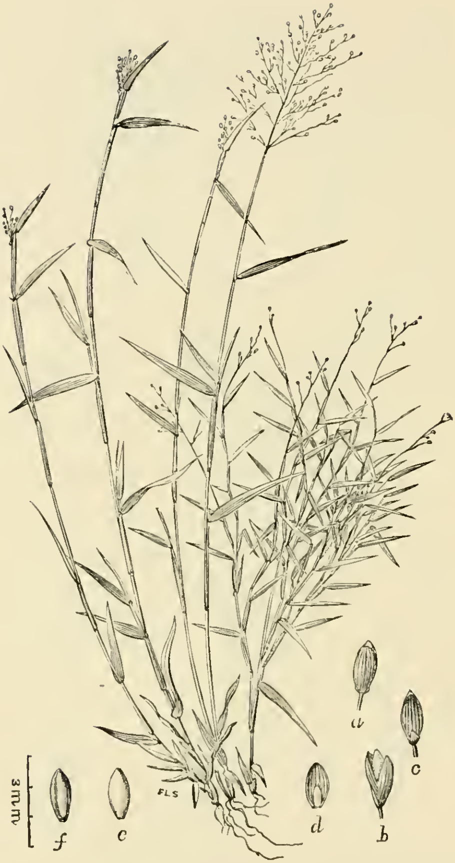

FIG. 366. **Panicum dichotomum** Linn. Sp. Pl. 58.—A slender, smooth, and finally much branched above, somewhat wiry perennial, 2 to 6 dm. high, with pale-green, spreading leaves 4 to 8 cm. long, and open panicles. Lateral panicles small and few-flowered. Spikelets (*a*, *b*, *c*) oblong-elliptical, nearly 2 mm. long, glabrous. The later growth of this species has the aspect of a little tree.—Dry thickets and open woodlands, New York to Nebraska and southward to the Gulf of Mexico. May–October.

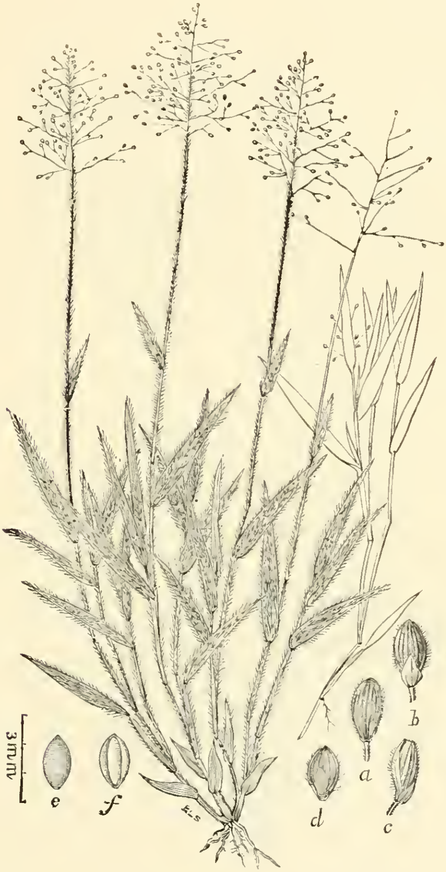

Fig. 367. **Panicum pubescens** Lam. Encycl., **4**: 748. 1797. Scribn. Grasses of Tennessee, **2**: 52, fig. 58, 1894. (*P. villosum* Ell.). A slender. erect, and finally much-branched perennial 1.5 to 5 dm. high, with flat, ascending, and rather firm, narrowly lanceolate, pubescent leaves 5 to 10 cm. long, and diffuse, ovate, or pyramidal panicles bearing obovate spikelets (*a*, *b*, *c*) which are 2 mm. in length.—Dry soil, usually in open woodlands, from New Jersey to South Dakota and southward to the Gulf. May–September.

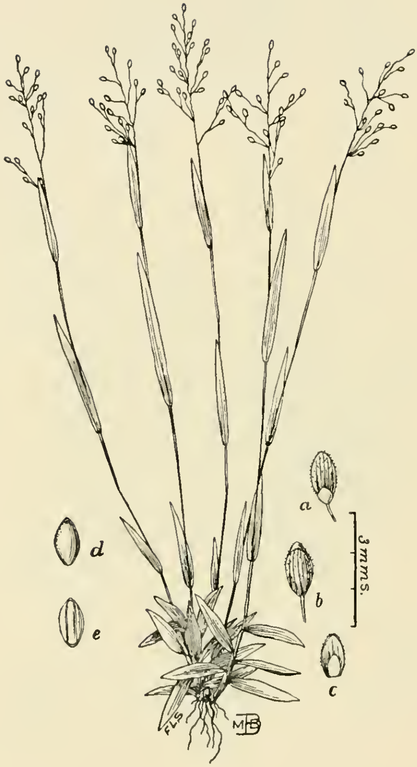

Fig. 368. **Panicum brittoni** Nash, Bull. Torr. Bot. Club, **24**: 191. 1897. Britton's Panic-grass.—A slender, erect, cæspitose perennial with rigid culms 1 to 2 dm. high, erect leaves, and ovate panicles 2 to 3 cm. long. Spikelets (*a*, *b*) oval or obovoid, obtuse, 1.4 mm. long, with the second and third glumes densely pubescent.—Pine barrens, New Jersey.

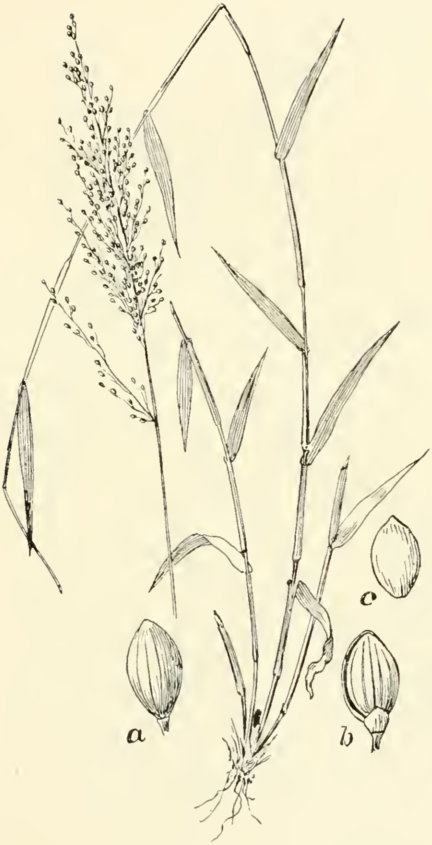

FIG. 369. **Panicum octonodum** J. G. Smith, n. sp. A slender, erect, unbranched, glabrous perennial 4 to 6 dm. high, with linear, rigid, erect or ascending leaves, and narrowly pyramidal, rather densely flowered panicles 5 to 10 cm. long; spikelets elliptical-ovate, acute, 1.2 mm. long; second and third glumes faintly 7-nerved and glabrous.—Texas. Allied to *P. lindheimeri* Nash.

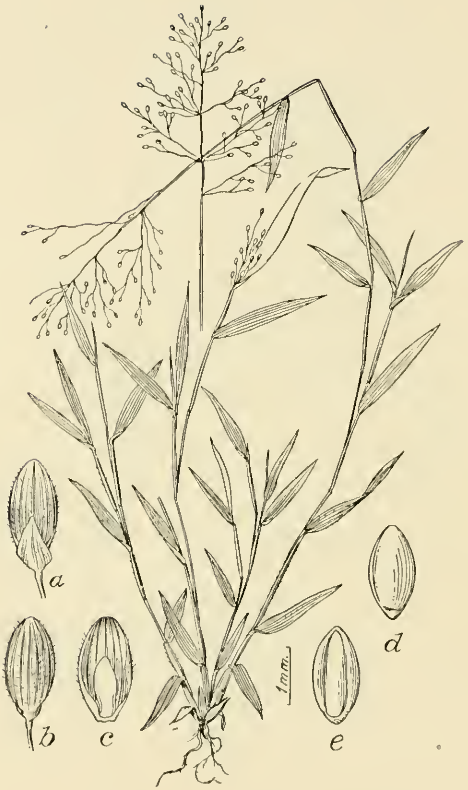

FIG. 370. **Panicum tsugetorum** Nash, Bull. Torr. Bot. Club, **25** : 86. 1898.—A slender, tufted, and at length much branched perennial 2 to 4.5 dm. high with the culm, sheaths, and lower surface of the leaves appressed-pubescent, and broadly ovate panicles 4 to 6.5 cm. long. Spikelets (*a*, *b*) about 1.8 mm. long, broadly obovate, the outer glumes pubescent with short, spreading hairs.—Open woods under evergreens, New York. June–August.

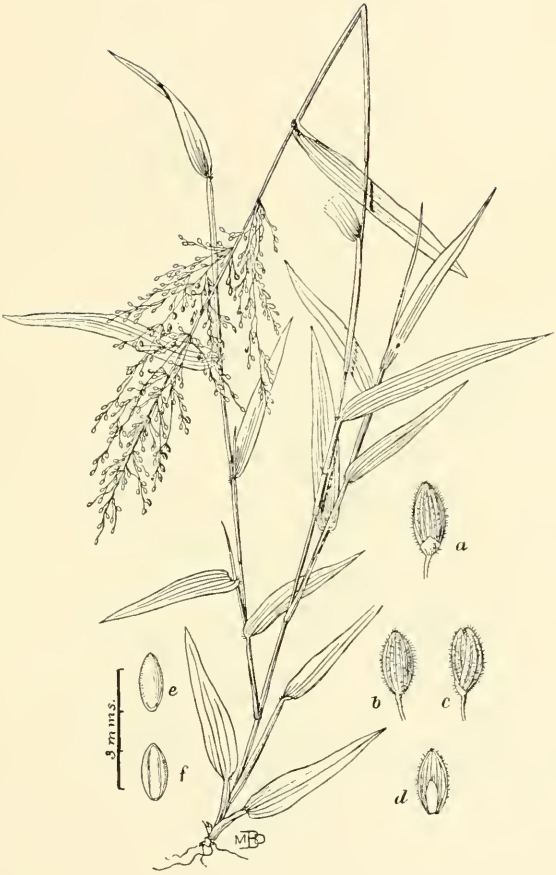

Fig. 371. **Panicum eatoni** Nash, Bull. Torr. Bot. Club, **25**: 84. 1898.—A smooth, erect, cæspitose perennial, finally much branched, with erect, lanceolate leaves and rather narrow and densely flowered panicles, 7 to 13 cm. long. Spikelets oval-oblong, about 1.6 mm. long, the second and third glumes densely pubescent with spreading hairs.—Maine to New York, near the coast.

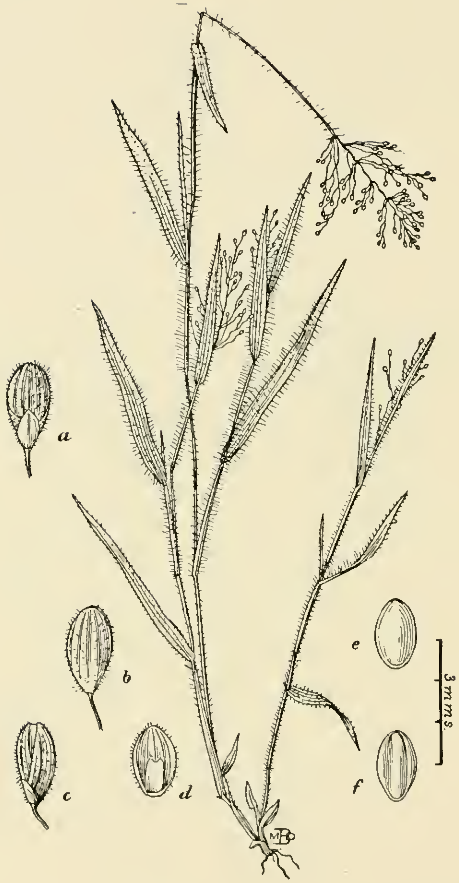

FIG. 372. **Panicum atlanticum** Nash, Bull. Torr. Bot. Club, **24**: 316. 1897.—A slender, erect, much-branched perennial 3 to 5 dm. high, with the culm, sheaths, and erect, linear-lanceolate leaves, papillate-pilose with long, white, spreading hairs. Panicle 4 to 6.5 cm. long. Spikelets obovate, obtuse, about 2 mm. long, the 9-nerved second and third glumes densely pubescent with short, spreading hairs.—In open woods, Maine to Virginia.

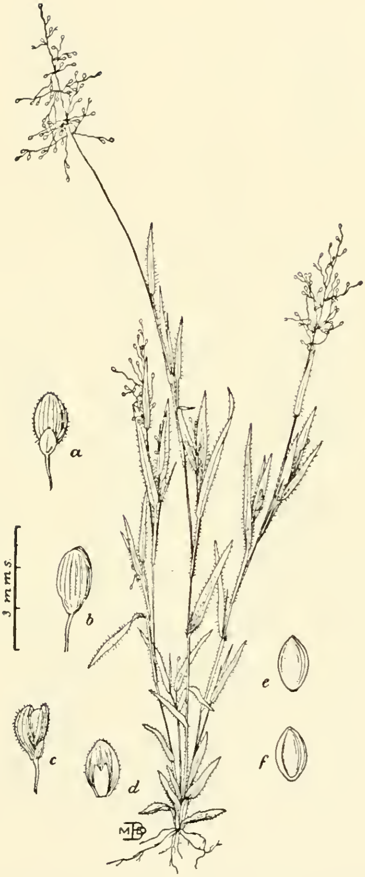

Fig. 373. **Panicum implicatum** Scribn. U. S. Dept. Agr. Div. Agros., Bull. **11**: 43. July 20, 1898.—A weak, slender, hairy perennial 3 to 5 dm. high, with rather short, mostly erect leaves and diffusely branching, pyramidal panicles 3 to 5 cm. long. Axis of the panicle and its flexuous branches pilose. Spikelets (*a*, *b*, *c*) 1.5 mm. long, obovate, obtuse, minutely pubescent.—Low grounds near the coast, from Maine to Delaware. June–August.

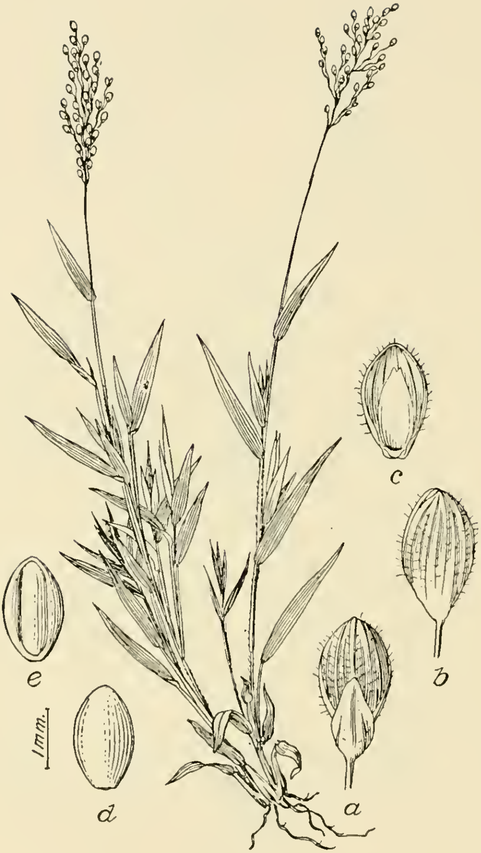

Fig. 374. **Panicum addisonii** Nash, Bull. Torr. Bot. Club, **25**: 83. 1898.—A rather slender, erect, or decumbent, and finally much-branched perennial 2.5 to 4 dm. high, with more or less pubescent sheaths, lanceolate and rather thickish, glabrous leaves, and ovate or oblong panicles 2 to 6 cm. long. Spikelets (*a*, *b*) broadly obovate, 2 mm. long, with the 9- to 11-nerved second and third glumes densely pubescent, with long spreading hairs.—Sandy soil, New Jersey. May–June.

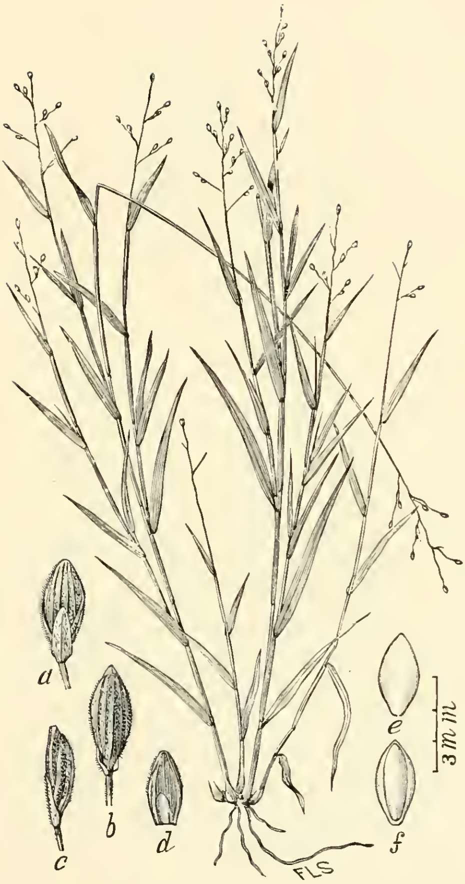

Fig. 375. **Panicum pedicellatum** Vasey, U. S. Dept. Agr. Div. Bot., Bull. **8**: 25. 1889.—A slender, erect, or ascending, and finally much-branched perennial 3 to 6 dm. high, with ascending, acute leaves 5 to 8 cm. long, open, few-flowered panicles, and oblong, minutely pubescent spikelets (*a*, *b*, *c*) about 4 mm. in length.—In open, rocky woodlands, Texas. May, June.

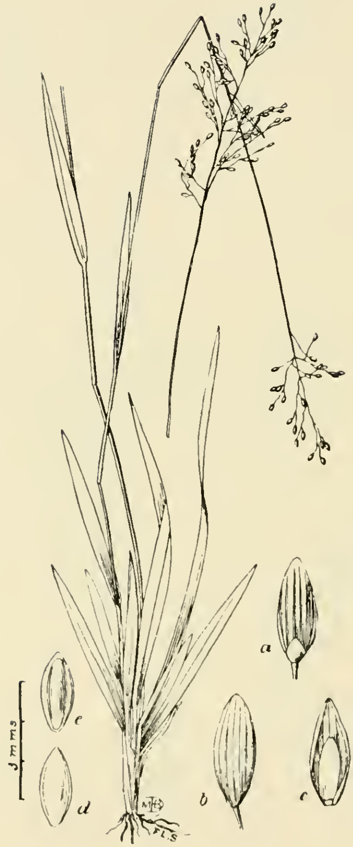

FIG. 376. **Panicum nudicaule** Vasey, U. S. Dept. Agr. Div. Bot., Bull. **8**:31. 1889.—A slender, erect, smooth perennial, 3 to 6 dm. high, with narrow, lanceolate leaves 5 to 10 cm. long, much-exserted, few-flowered panicles 5 to 8 cm. long, and elliptical-oblong, glabrous spikelets (*a*, *b*) 2 to 5 mm. long.—Swamps, Santa Rosa County, Florida. April, May.

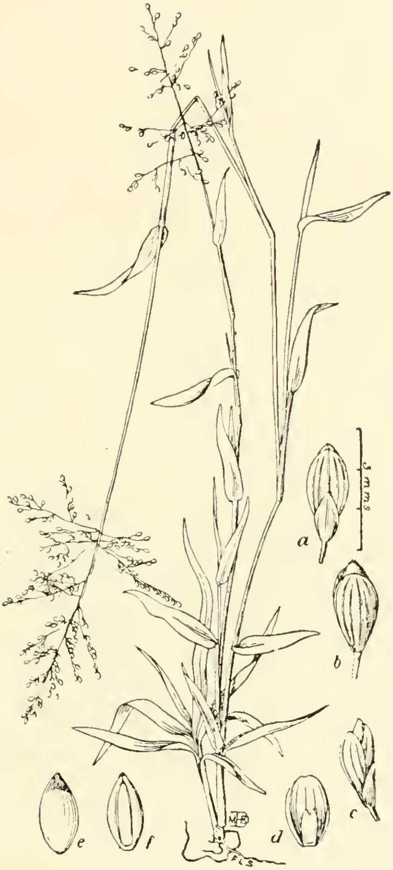

FIG. 377. **Panicum webberianum** Nash, Bull. Torr. Bot. Club, **23**: 149. 1896. WEBBER'S PANIC-GRASS.—A rather rigid, erect or ascending and more or less branched perennial 2 to 4 dm. high, with lanceolate, spreading leaves and ovate, spreading panicles 6 to 9 cm. long. Spikelets (*a*, *b*, *c*) elliptic or obovate, 2.5 mm. long with the second and third glumes minutely pubescent, as is the fourth or flowering glume near its obtuse apex.—Low pine lands, Florida. May–August.

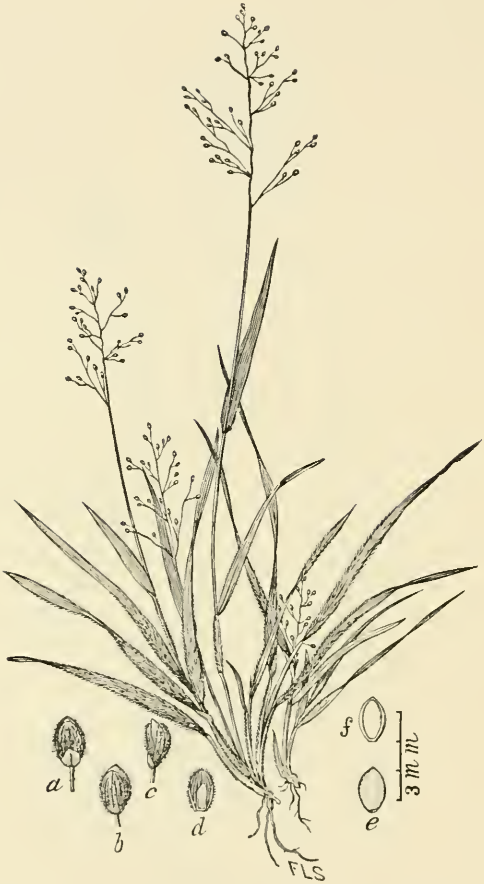

Fig. 378. **Panicum laxiflorum** Lam. Encycl. **4** : 748. 1797.—A slender, densely tufted perennial about 3 dm. high, with rather long, pale-green, soft leaves and loosely few-flowered panicles 4 to 6 cm. long. Sheaths papillate-pilose with spreading or deflexed hairs. Spikelets (*a*, *b*, *c*) ovate-elliptical, obtuse, about 2 mm. long. Second and third glumes pubescent.—Dry or moist, open woodlands, Virginia to Florida and westward to Tennessee and Louisiana. March-October.

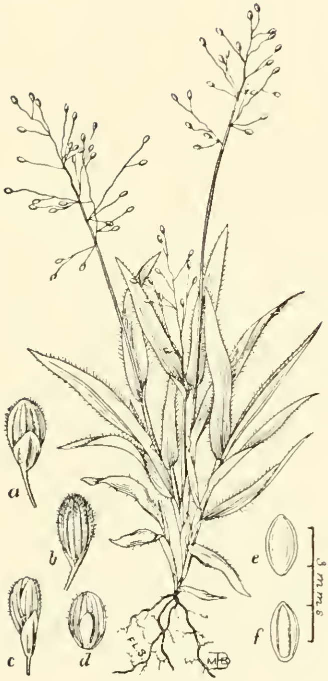

Fig. 379. **Panicum ciliatifolium** Kunth, Revis. Gram. **1**: 36. 1835. (*P. ciliatum* Ell. not Thunb.).—A slender, densely tufted perennial 1 to 3 dm. high, with rather short, ciliate leaves and diffuse panicles. Leaves 2 to 6 cm. long, 4 to 12 mm. wide. Panicles ovate-pyramidal, 2 to 3 cm. long. Spikelets (*a*, *b*, *c*) about 2 mm. long, glabrous or minutely pubescent.—Moist open woodlands in sandy soil, North Carolina to Florida and westward to Mississippi. March–October.

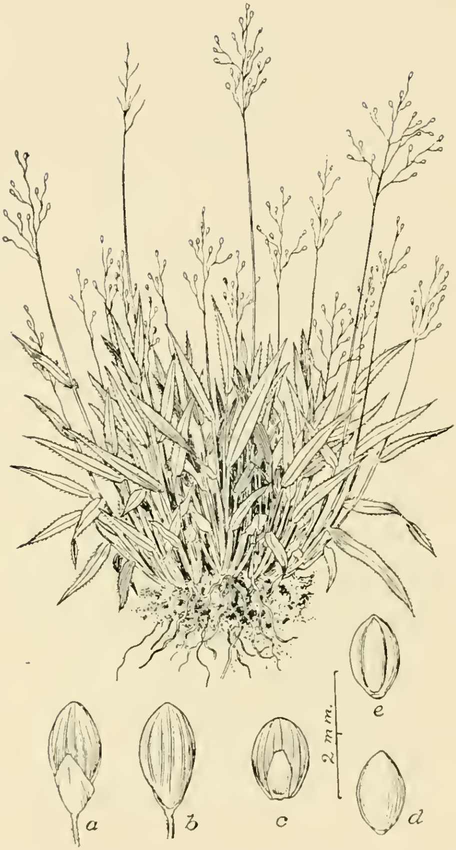

FIG. 380. **Panicum polycaulon** Nash, Bull. Torr. Bot. Club. **24**: 200. 1897.—A low, pale green, densely cæspitose perennial 1 to 2 dm. high, with erect or ascending, oblong-lanceolate leaves 2 to 7 cm. long and ciliate on the margins, and ovate panicles 2 to 3 cm. long. Spikelets (*a*, *b*) about 1.5 mm. long, obovate, obtuse, the 7-nerved second and third glumes glabrous.—Florida.

This is separated from the closely allied *P. ciliatifolium* Kunth by its narrower leaves, more slender culms. and smaller, glabrous spikelets.

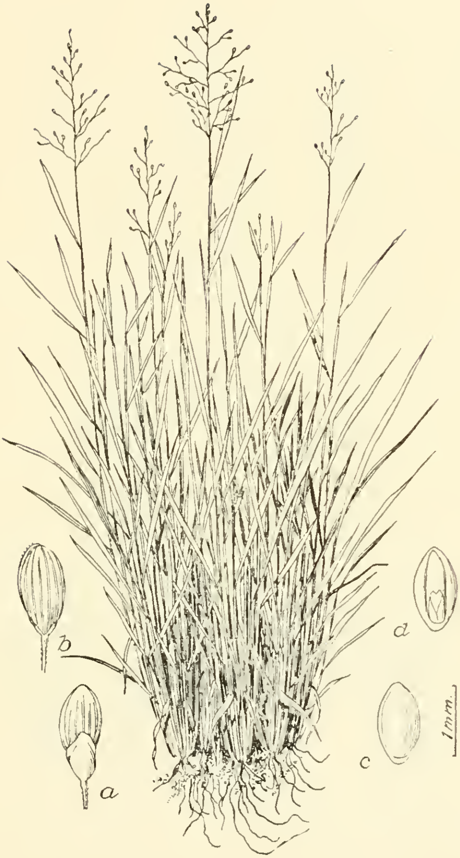

FIG. 381. **Panicum glabrifolium** Nash. Bull. Torr. Bot. Club, **24**: 196. 1897.—A slender, densely cæspitose, and rigidly erect, wiry perennial 1.5 to 4 dm. high, with narrowly linear, erect, and rather rigid leaves and ovate panicles 4 to 6 cm. long. Spikelets (*a*, *b*) 0.5 to 0.8 mm. long, obovate, the 5-to 7-nerved second and third glumes glabrous.—Florida.

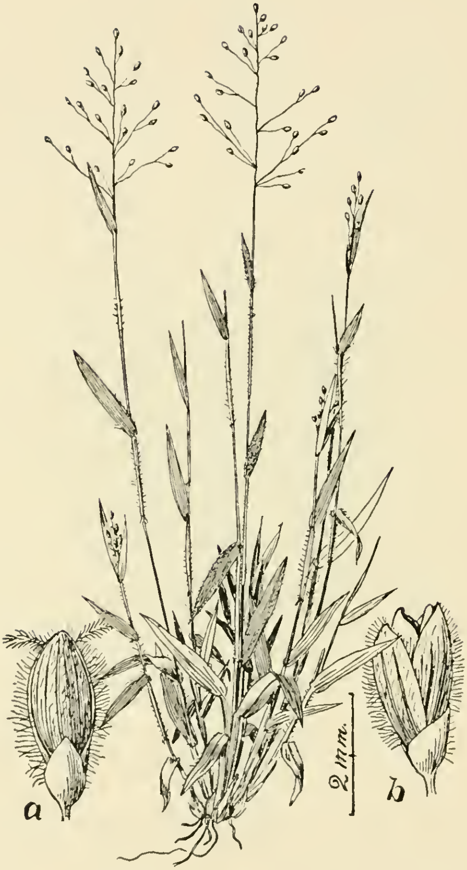

FIG. 382. **Panicum ciliiferum** Nash, Bull. Torr. Bot. Club, **24**: 195. 1897.—A densely cæspitose, erect, or finally much-branched and decumbent perennial 2 to 8 dm. high, with culms, sheaths, and lower surface of leaves pubescent or hirsute, and broadly ovate panicles 7 to 9 cm. long. Spikelets obovate, subacute, 3 mm. long, the 9-nerved second and third glumes strongly pubescent.—Florida.

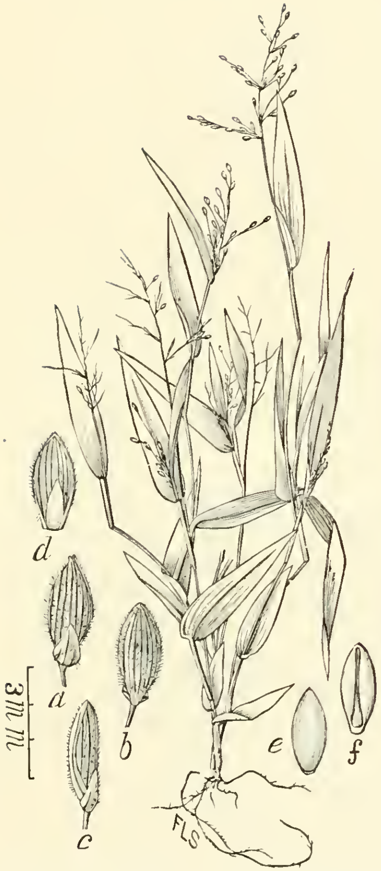

Fig. 383. **Panicum manatense** Nash, Bull. Torr. Bot. Club, **24**: 42. 1897.—A glabrous, much-branched perennial with diffusely spreading culms 2 to 4 dm. long, nearly erect leaves 3.5 to 9 cm. long, and ovate, rather few-flowered panicles 4 to 6 cm. long. Spikelets (*a*, *b*, *c*) elliptical-oblong, pubescent, about 3.5 mm. long, with distinct papillæ between the nerves of the second and third glumes.—Florida and (?) Georgia to Louisiana.

Distinguished from *P. commutatum* by its larger and more acute spikelets. Very closely allied to *P. joorii* Vasey.

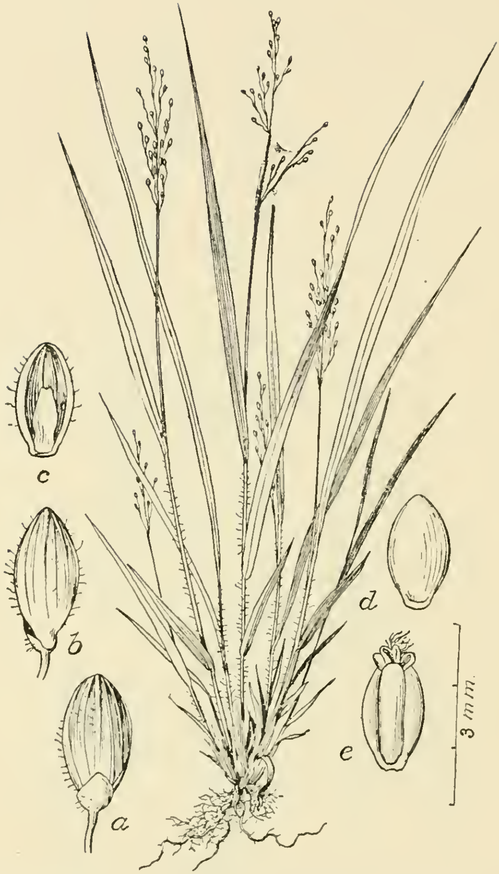

FIG. 384. **Panicum enslini** Trin. MSS., Nees, Agros. Bras., **2**: 227. 1829. (*P. linearifolium* Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 42 Pl. 1.)—A slender, erect, densely cæspitose perennial 2 to 4 dm. high, with long, linear-lanceolate, erect leaves and simple, open panicles 5 to 8 cm. long. Spikelets (*a*, *b*) 2 to 2.5 mm. long, obovate, obtuse, with the 7-nerved second and third glumes glabrous or sparingly pilose.—New England southward to Virginia and westward to Texas. To be compared with *P. tenue* Muhl.

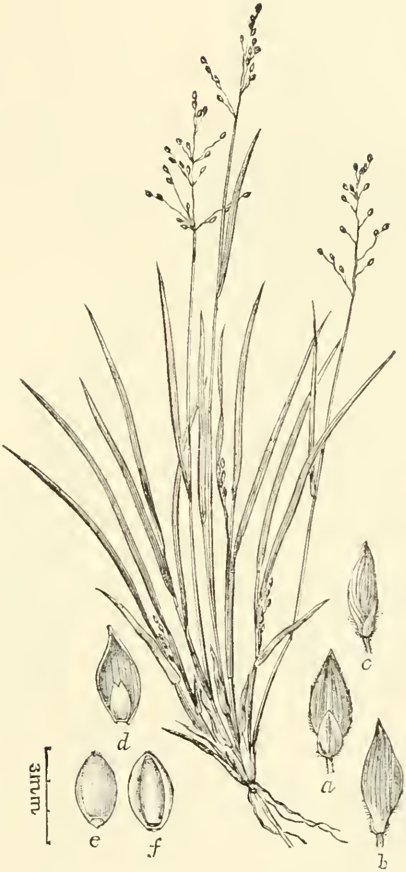

FIG. 385. **Panicum depauperatum** Muhl. Gram. 112. 1817.—A slender, erect, or ascending perennial, usually much branched near the base, about 1.5 to 4 dm. high, with very narrow, erect leaves 8 to 20 cm. long, few-flowered narrow panicles 4 to 10 cm. long, and rather smooth spikelets (*a*, *b*, *c*) 3 to 4 mm. long.—Open woodlands and gravelly fields from Nova Scotia and Manitoba southward to Florida and Texas. May–August.

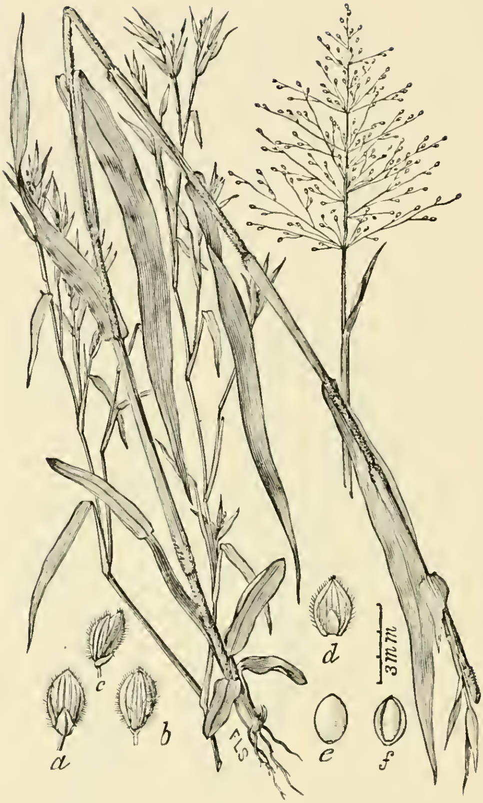

Fig. 386. **Panicum viscidum** Ell. Bot. S. Car. & Ga., **1** : 123. 1817. (*P. scoparium* Michx. not Lam.).—A rather stout, erect or ascending, finally much branched perennial, 6 to 12 dm. high. Leaves rather broad, very acute, those on the primary stem 12 to 25 cm. long. Panicle 10 to 15 cm. long, ovate or subpyramidal, many-flowered. Spikelets (*a*, *b*, *c*) 2 mm. long, rounded-obovate, the whole plant, or at least the culm and sheaths densely pubescent with soft, spreading hairs, and all parts somewhat viscid when fresh.—Low ground, borders of thickets, etc., from New Jersey and Delaware southward to Florida and westward to Indiana and Texas. June–October.

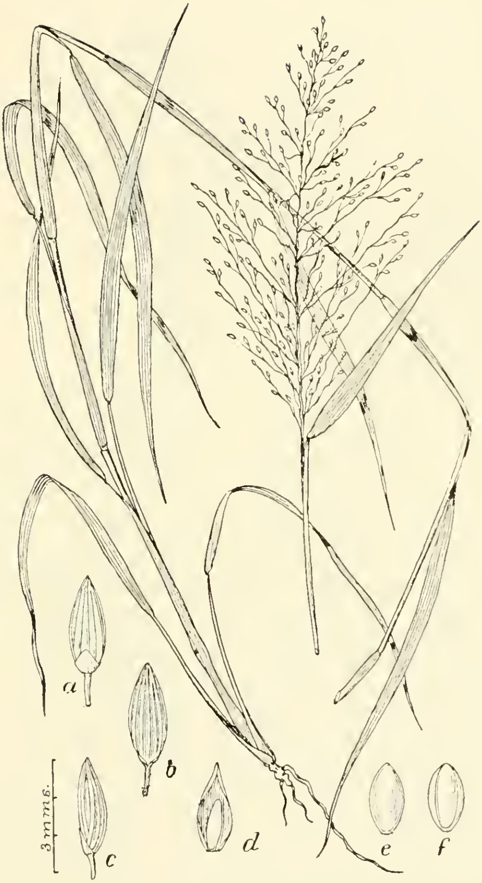

FIG. 387. **Panicum scabriusculum** Ell. Sk. Bot. S. Car. & Ga. **1**: 121. 1817.—A rather stout, erect, and finally sparingly branched perennial, 9 to 15 dm. high, with narrowly lanceolate leaves 8 to 15 mm. wide and 7 to 20 cm. long. Panicle spreading, 12 to 20 cm. long. Spikelets (*a*, *b*, *c*) 2 mm. long, glabrous.—Low grounds, North Carolina to Florida and westward to Texas. May–August.

This species is closely allied to *Panicum viscidum*.

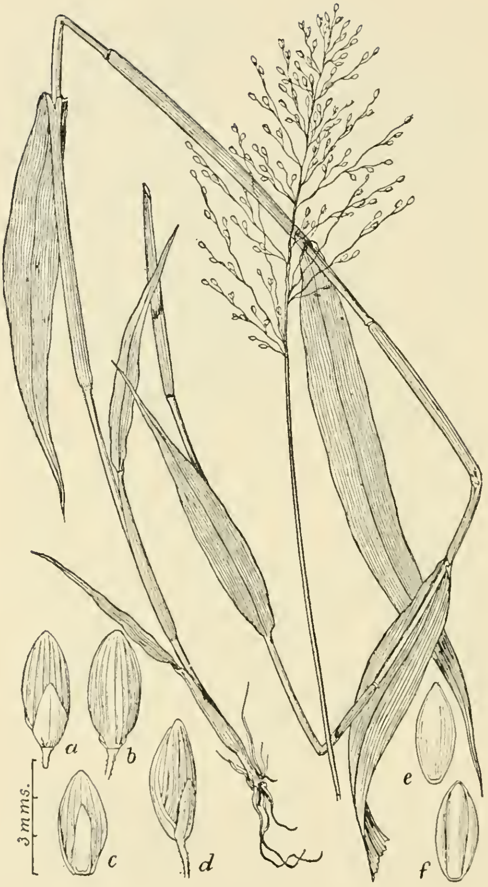

FIG. 388. **Panicum clandestinum** Linn. Sp. Pl. 58.—A stout, erect or ascending perennial, finally branching above, 8 to 12 dm. high, with broad leaves and terminal, diffuse panicles 8 to 13 cm. long. Spikelets (*a*, *b*, *d*) oblong, smooth or finely pilose, 3 mm. long. The panicles on the branches are for the most part included within the uppermost sheaths.—Low thickets, Quebec to Michigan, and southward to Georgia and Texas. May–September.

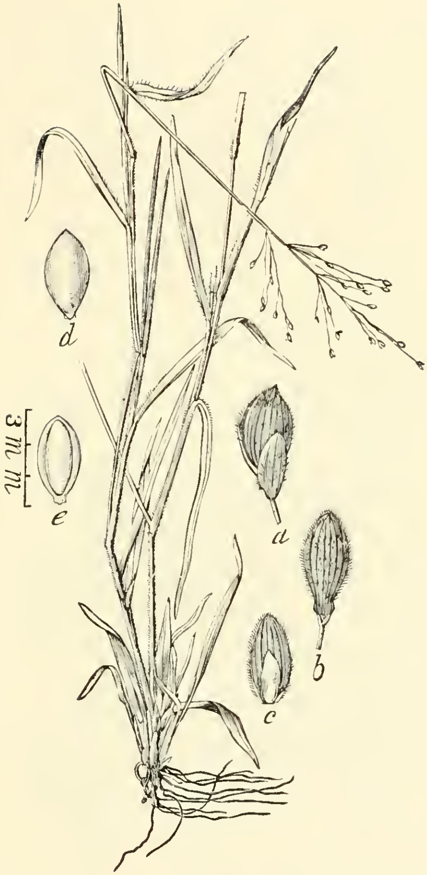

Fig. 389. **Panicum malacon** Nash, Bull. Torr. Bot. Club, **24**: 197. 1897.—A rather rigid, erect perennial, finally much branched near the base, with bearded nodes, hairy sheaths and stems, firm leaves 3 to 10 cm. long, and open few-flowered panicles 7 to 10 cm. long. Spikelets (*a*, *b*) obovate, obtuse, pubescent, 3 to 3.5 mm. long. Whole plant pubescent, with white, ascending hairs.—New Jersey (?), high pine lands of southern Florida. May.

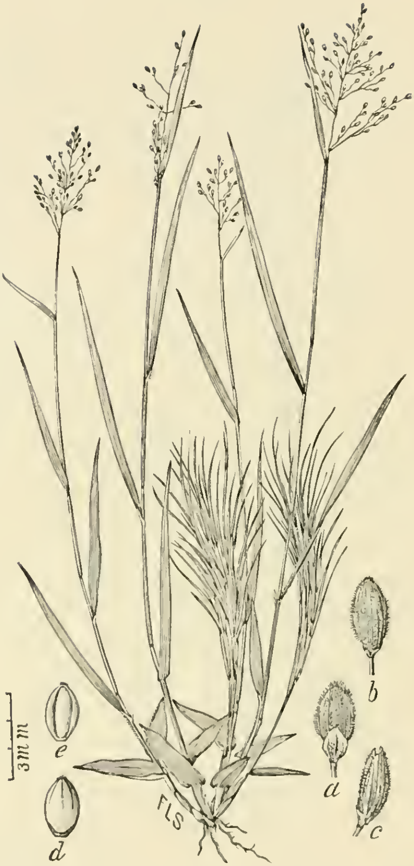

Fig. 390. **Panicum angustifolium** Ell. Bot. S. Car. & Ga. **1**: 129. 1817.—A rather slender but rigid, erect, more or less pubescent perennial, 3 to 6 dm. high, at first simple, finally much branched throughout. Leaves of the primary stems erect, 8 to 15 cm. long and 4 to 6 mm. wide; those of the wiry branches shorter and much narrower. Panicles 7 to 10 cm. long, spreading, and rather loosely flowered. Spikelets (*a*, *b*, *c*) 3 mm. long, oblong, obtuse; outer glumes finely pubescent.—Dry soil, North Carolina to Florida and westward to Missouri and Texas. March–October.

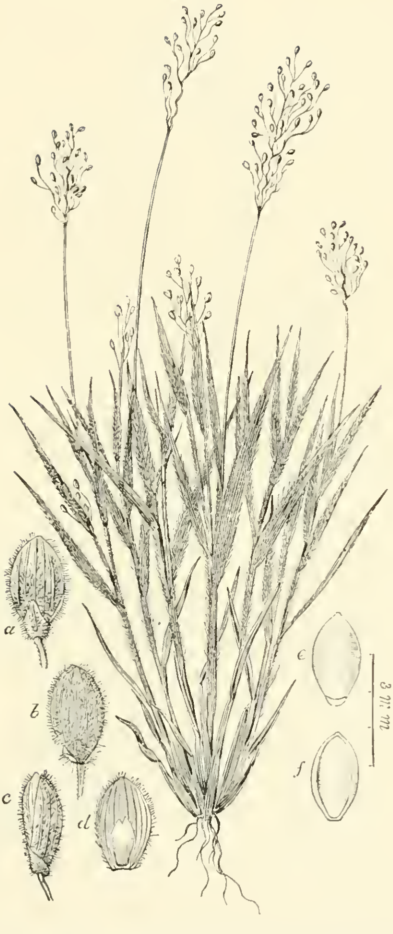

Fig. 391. **Panicum wilcoxianum** Vasey, U. S. Dept. Agr. Div. Bot., Bull. **8**: 32. 1889.—A rather slender, very hairy, and finally much-branched perennial 2 to 2.5 dm. high, with erect, acute leaves, and small, spreading panicles 2 to 3 cm. long. Spikelets (*a, b, c*) oblong, obtuse, 3 mm. long, with pubescent outer glumes.—Dry prairies, Kansas northward through Nebraska and South Dakota to Manitoba. June–August.

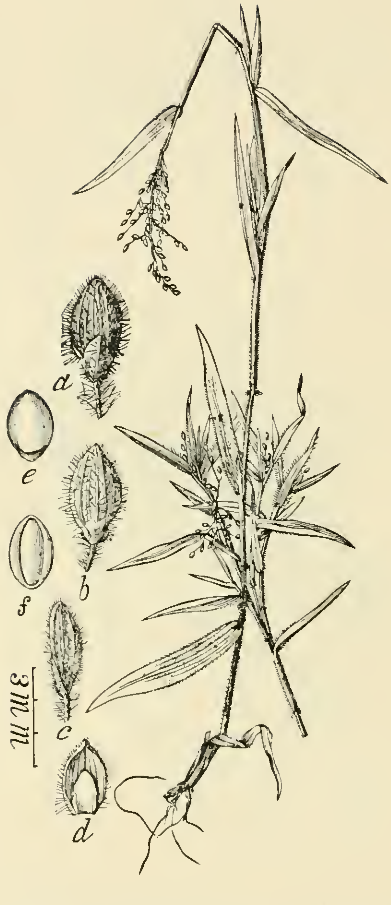

FIG. 392. **Panicum malacophyllum** Nash, Bull. Torr. Bot. Club, **24** : 198. 1897.—A hairy, erect, or ascending perennial, 2 to 4 dm. high, at length much branched above with narrow, softly pubescent leaves and open panicles 3 to 5 cm. long, the flexuous branches bearing obovate spikelets (*a*, *b*, *c*) 3 to 3.5 mm. long. Outer glumes densely pubescent, with rather long, spreading hairs.—Cedar barrens, etc., Tennessee to Arkansas and Indian Territory. May–July.

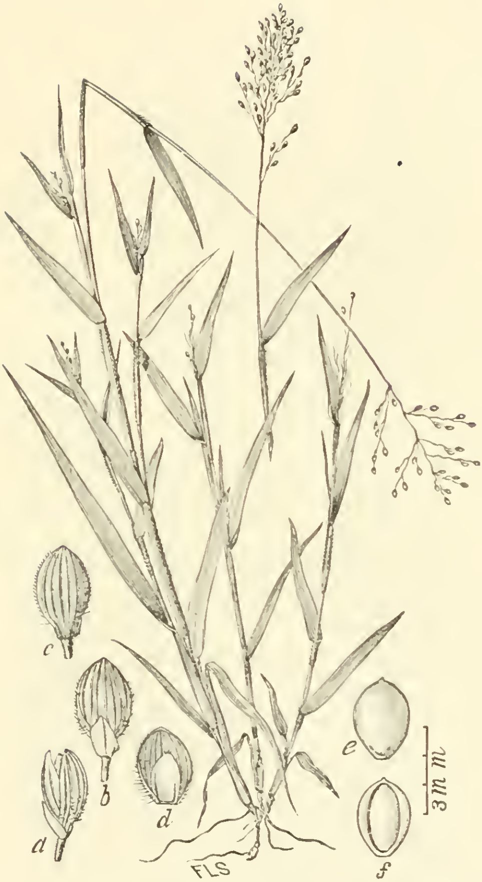

FIG. 393. **Panicum scribnerianum** Nash, Bull. Torr. Bot. Club. 22: 421. 1895. (*P. scoparium* A. Gray in part, not Lam.).—An erect and finally branching perennial 1.5 to 6 dm. high, with usually papillate-pilose sheaths, more or less spreading, flat leaves, which are smooth and scabrous beneath, and small, ovoid panicles 2 to 3 cm. long. Spikelets (*a, b, c*) obovoid, 3 mm. long, nearly glabrous.—In dry or moist soils from Maine and Ontario westward to Wyoming, and southward to Tennessee, Texas, and Arizona. May–September.

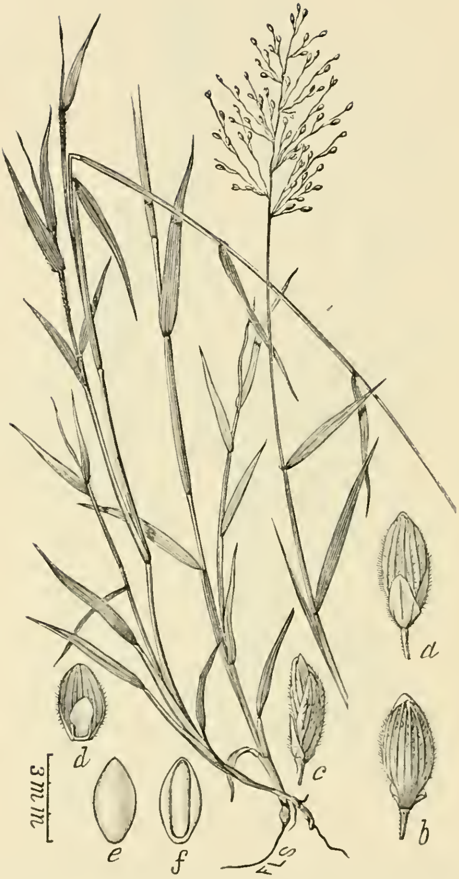

FIG. 394. **Panicum pauciflorum** Ell. Sk. Bot. S. Car. & Ga. **1**: 120.—A comparatively stout, usually erect, and finally branching perennial 3 to 5 dm. high, with hairy sheaths, narrow leaves, and small, few-flowered panicles. Leaves smooth above, roughened beneath. Spikelets (*a*, *b*, *c*) oval or oblong, 4 mm. long, the second and third glumes pubescent. Loose or more or less sandy and usually damp soils.—Georgia and South Carolina. May–October.

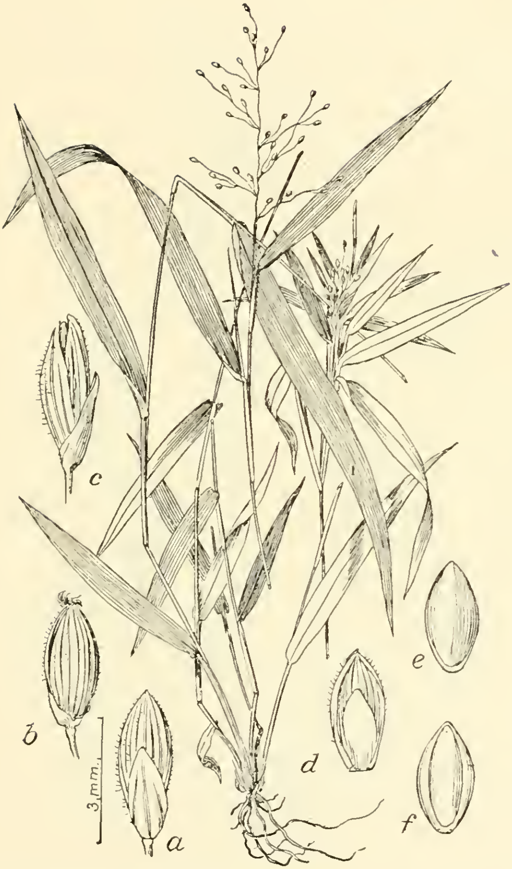

FIG. 395. **Panicum equilaterale** Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 42. Pl. 2. 1898.—A rather stout, erect, and densely cæspitose, glabrous perennial 3 to 6 dm. high, with long, lanceolate leaves and open panicles 7 to 10 cm. long. Spikelets (*a*, *b*, *c*) elliptical or obovate, obtuse, 3 to 3.5 mm. long, with the first glume 3-nerved, the second and third nearly equal, 7- to 9-nerved, slightly pubescent.—Pine and "hummock" lands, Florida. June-August.

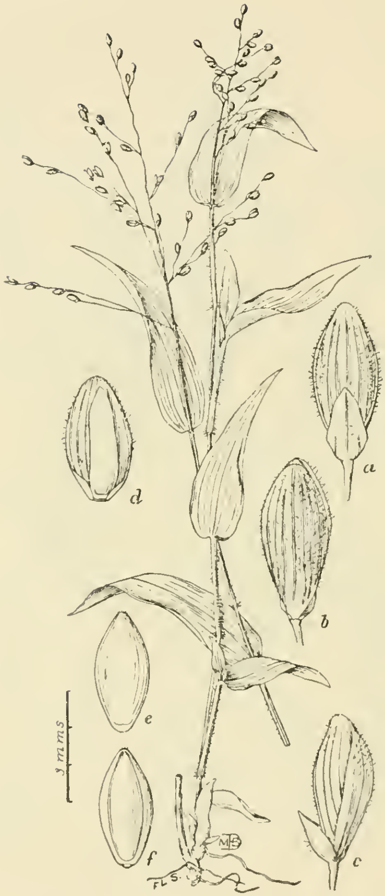

FIG. 396. **Panicum latifolium** Linn. Sp. Pl. Ed. 1. 58. 1753, excluding reference to Sloane. (*P. walteri* Poir.; *P. porterianum* Nash.).—A rather slender, branching perennial 3 to 6 dm. high, with broad, ovate-lanceolate leaves, and few-flowered, nearly simple panicles. Spikelets (*a. b. c*) ovate-elliptical or pear-shaped, obtuse, about 4 mm. long, outer glumes shortly pubescent.—Common in open woodlands and thickets, Maine and Ontario to Minnesota, and southward to Florida and Texas. May–October.

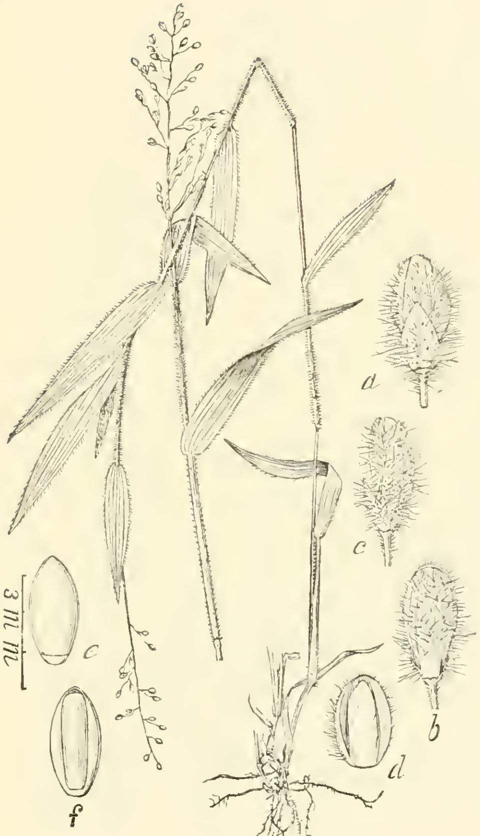

FIG. 397. **Panicum leibergii** Scribn. U. S. Dept. Agr. Div. Agros. Bull. **8** : 6. pl. 3. (*P. scoparium leibergii* Vasey, Contr U. S. Nat. Herb., **3** : 31.)—A slender, erect, or ascending perennial grass, 3-6 dm. high, with rather broad, flat leaves and few-flowered panicles of comparatively large, obtuse spikelets (*a*, *b*, *c*) 3 to 4 mm. long, the outer glumes papillate-pilose with stiff, spreading hairs.—Iowa, Minnesota, the Dakotas, and Missouri. May-July.

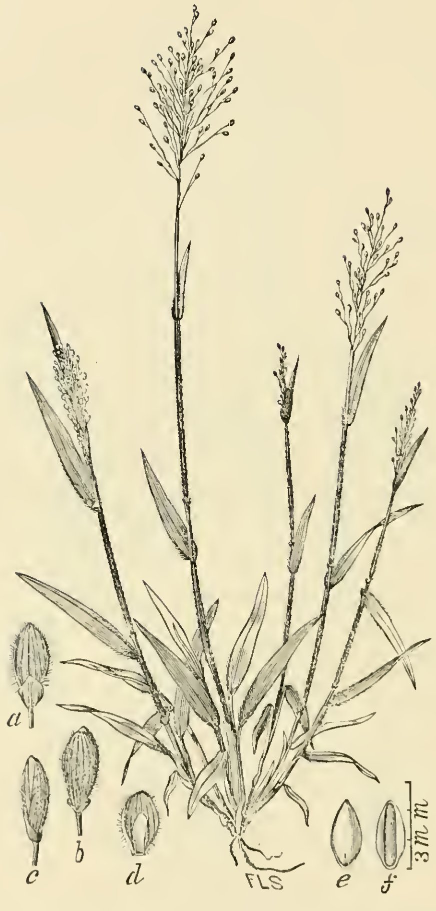

FIG. 398. **Panicum ovale** Ell. St. Bot. S. Car. & Ga. **1** : 123. 1817.—A rather stout, erect, and finally much-branched perennial with villous sheaths and leaves (later becoming smooth) and ovate panicles 5 to 6 cm. long. Spikelets (*a*, *b*, *c*) obovate or oval, 2.5–3 mm. long, the second and third glumes pubescent. Leaves of the culm erect, 6 to 12 cm. long and 4 to 7 mm. wide.—South Carolina to Florida.

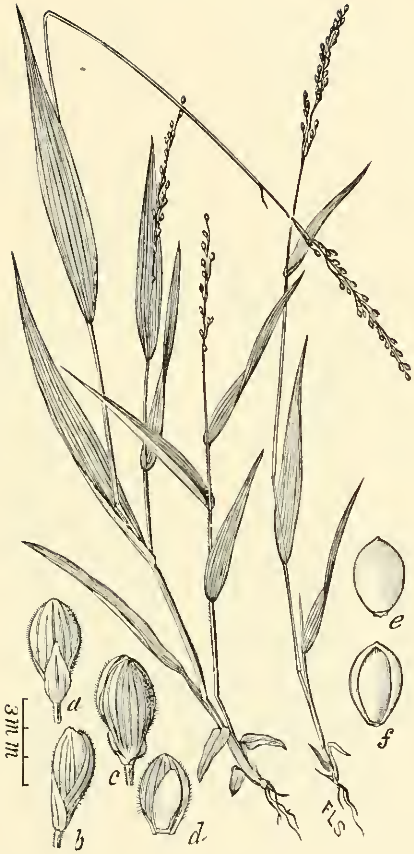

FIG. 399. **Panicum xanthophysum** A. Gray, Ann. Lyc. N. Y. **3**: 233. 1835.—A slender, or occasionally rather stout, erect perennial, 3 to 6 dm. high, sparingly branching near the base, with broadly lanceolate leaves 6 to 15 cm. long, and simple, rather few-flowered, racemose panicles 3 to 8 cm. long. Spikelets (*a*, *b*, *c*) obovoid, obtuse, about 3 mm. long, the second and third glumes pubescent.—Dry, sandy soil, Maine to New Jersey and westward to Minnesota and Manitoba. June–September.

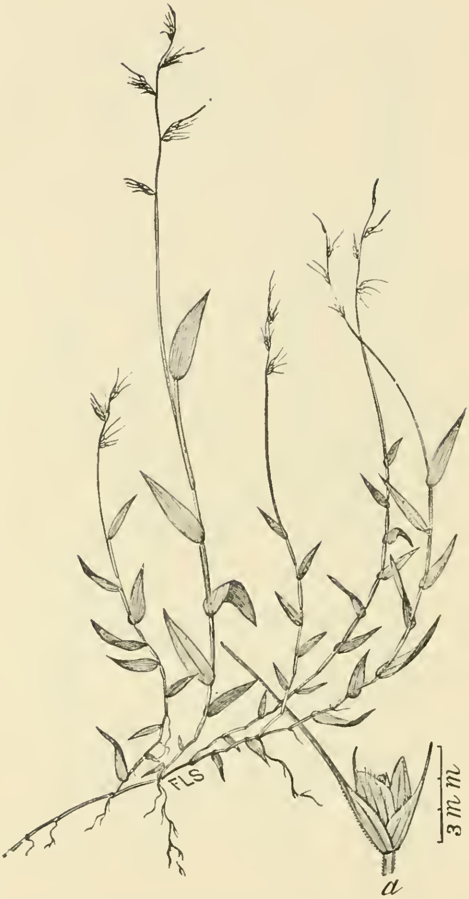

FIG. 400. **Oplismenus hirtellus** (Linn.) R. & S. Syst. **2** : 481. (*Panicum hirtellum* Linn.) CREEPING BEARD-GRASS.—A weak, decumbent, and more or less extensively creeping perennial 3 to 6 dm. long, with broad, flat leaves, and simple, racemose panicles 6 to 8 cm. long. Spikelets (*a*) about 3 mm. long.—Moist woodlands and swamps. Georgia and Florida, westward to Louisiana and Texas. [Mexico and South America.] June-October.

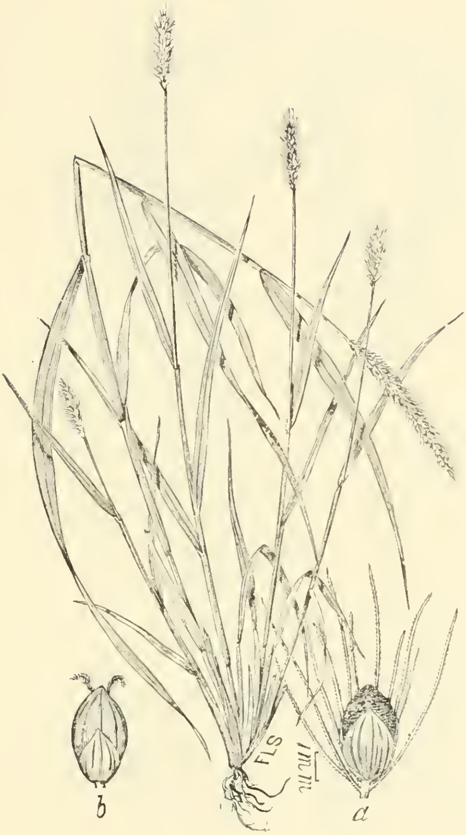

Fig. 401. **Chaetochloa glauca** (Linn.) Scribn. U. S. Dept. Agr. Div. Agros., Bull. **4**: 39. 1897. (*Panicum glaucum* Linn.; *Setaria glauca* Beauv.) Yellow Foxtail.—An erect, leafy annual 3 to 6 dm. high, usually much branched near the base, with flat leaves and bristly, spike-like panicles 2 to 8 cm. long. Bristles 5 to 10 to each spikelet, usually yellow. Spikelets about 3 mm. long, with the second glume about half the length of the transversely rugose flowering-glume.—Fields and waste places about dwellings, etc., throughout. Naturalized from Europe. June–September.

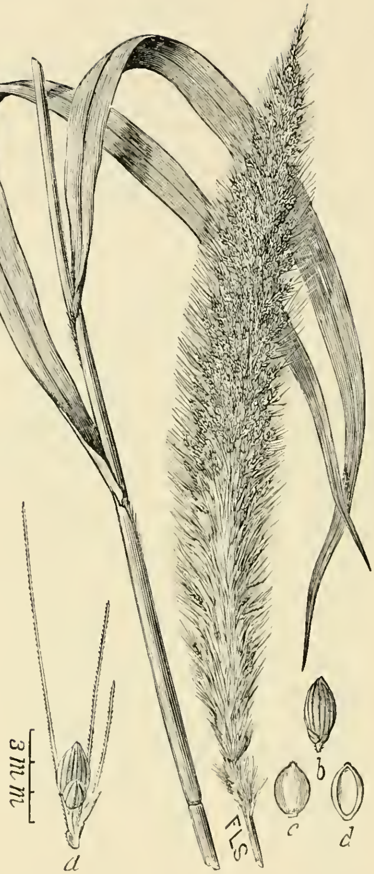

FIG. 402. **Chaetochloa magna** (Griseb.) Scribn. U. S. Dept. Agr. Div. Agros., Bull. **4**: 39. 1897. (*Setaria magna* Griseb.) GIANT MILLET.—A stout, erect, leafy annual (?) 18 to 36 dm. high, much branched below, with broad, flat leaves and bristly, densely flowered panicles 15 to 35 cm. long. Spikelets (*b*) 2 mm. long, with the second glume as long as the smooth fruiting glume.—Low grounds along the coast from southern Maryland and Virginia southward to Florida and westward to Texas. [West Indies and Bermudas.] July–October.

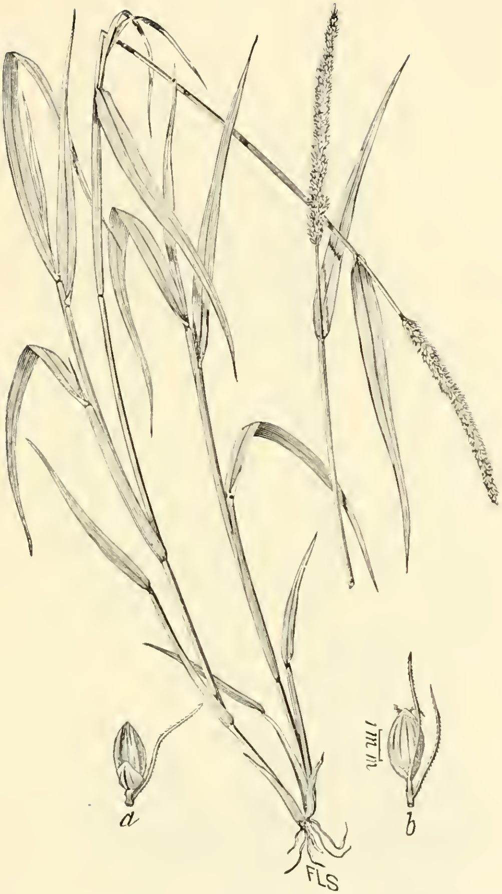

FIG. 403. **Chaetochloa verticillata** (Linn.) Scribn. U. S. Dept. Agr., Div. Agros., Bull. **4** : 39. 1897. (*Panicum verticillatum* Linn.; *Setaria verticillata* Beauv.) BRISTLY FOXTAIL.—A leafy, upright annual 3 to 6 dm. high, much branched near the base, with rather slender, spike-like panicles 2 to 6 cm. long. Bristles as long as or a little exceeding the spikelets, downwardly barbed.—Fields and waste places, New England to Virginia and Kentucky, westward to South Dakota and Nebraska. Naturalized from Europe. June–September.

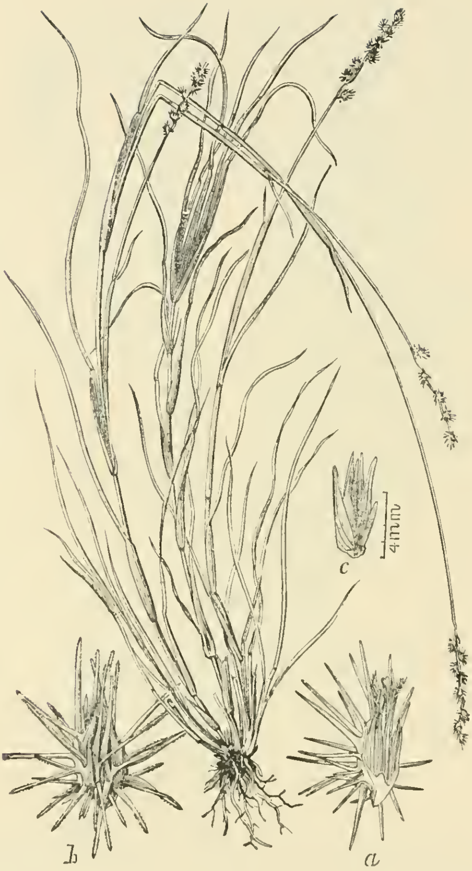

FIG. 404. **Cenchrus gracillimus** Nash, Bull. Torr. Bot. Club, **22**: 300. 1895. SLENDER SAND-BUR.—An ascending, sparingly branched, slender, leafy annual 3 to 6 dm. high, with loosely flowered, slender spikes 3 to 5 cm. long. Involucre (*b*) ovate, smooth, with numerous long, slender, usually purplish spines.—High pine lands, Florida. April–September.

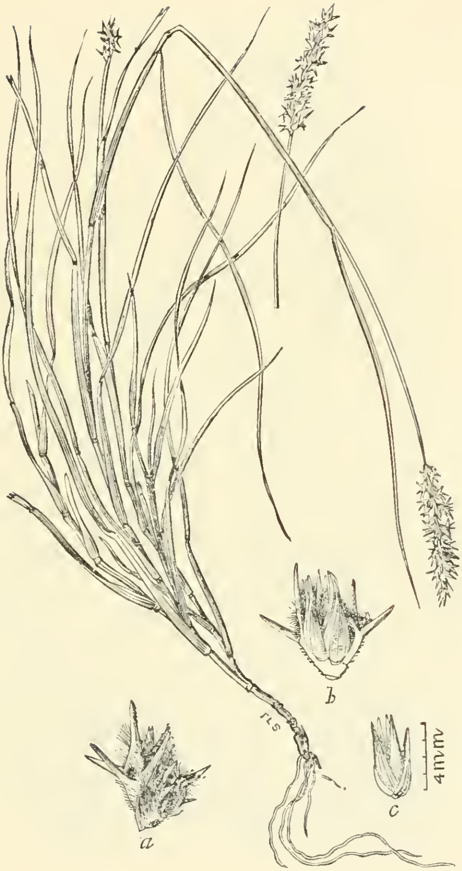

Fig. 405. **Cenchrus incertus** M. A. Curt. Bost. Journ. Nat. Hist. **1** : 135. 1837. (*C. strictus* Chapm. Coult. Bot. Gaz. **3** : 20. 1878.) Southern Sand-bur.—A smooth, ascending, and more or less branched perennial (?), 4.5 to 9 dm. high, with flat leaves and slender spikes 5 to 8 cm. long. Spikelets inclosed in a bur-like involucre (*a*) which is naked below, with 6 to 12 stout spines above.—Sandy soil along the coast, Georgia to Florida and westward to Texas. June–October.

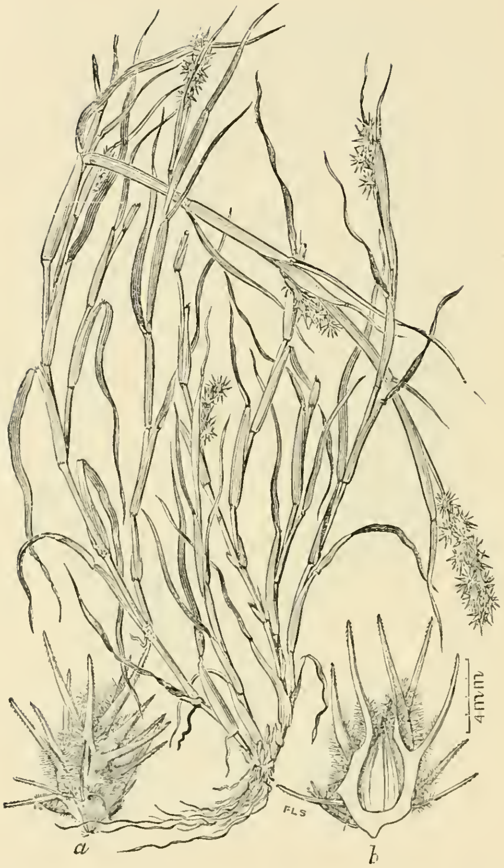

Fig. 406. **Cenchrus macrocephalus** Scribn. new name. (*C. tribuloides macrocephalus* Doell, Flor. Bras., **2** : part 2, 312. 1877. ex char.) Large Sand-bur.—A coarse, much branched and leafy annual, with prostrate or ascending culms 3 to 6 dm. long, and dense spikes 2 to 8 cm. long. Involucres or "burs" (*a*) pubescent, about 8 mm. long and 6 mm. broad, with numerous stout spines.—Sands along the coast, New Jersey and southward (?), New Orleans.

Burs about twice the size of those of *Cenchrus tribuloides.*

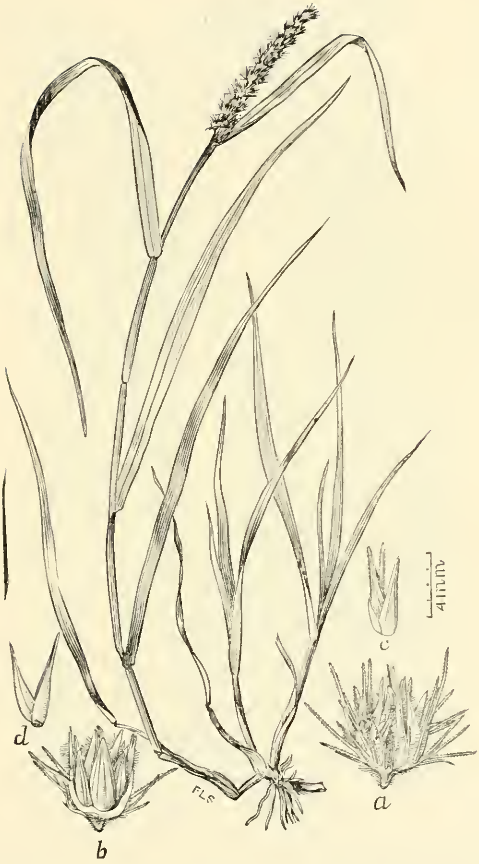

FIG. 407. **Cenchrus echinatus** Linn. Sp. Pl. 1488. COCK SPUR.—A stout, erect or ascending perennial 3 to 10 dm. high, with rather broad, flat leaves and cylindrical, dense spikes 8 to 12 cm. long. Involucres (*a*) pilose or downy, with many spines above and bristly near the base.—Dry soil, fields and waste places, South Carolina to Florida and westward to Texas. [Mexico and southward.] March-September.

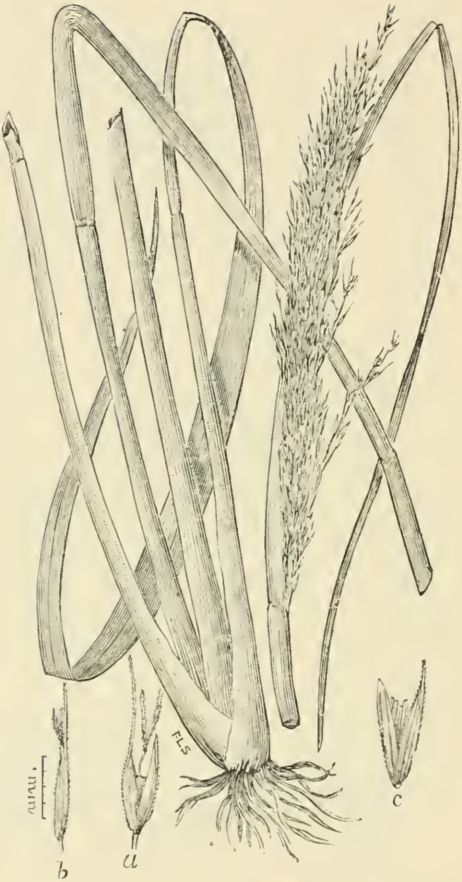

FIG. 408. **Zizaniopsis miliacea** (Michx.) Doell & Aschers. (*Zizania miliacea* Michx. Flor. Bor. Am. **1** : 71. 1803.) WATER MILLET.—A stout, erect, glabrous, semiaquatic grass 12 to 45 dm. high, from long, creeping rootstocks, with long, broad leaves and dense panicles 30 to 45 cm. long. Spikelets staminate (*c*) and pistillate (*a, b*), the former 6 to 8 mm. long, awnless, the latter about 6 mm. long, the outer glume with an awn 2 to 6 mm. long.—Swamps, etc., Florida to Texas and (according to Riddell) northward to Ohio. May–August.

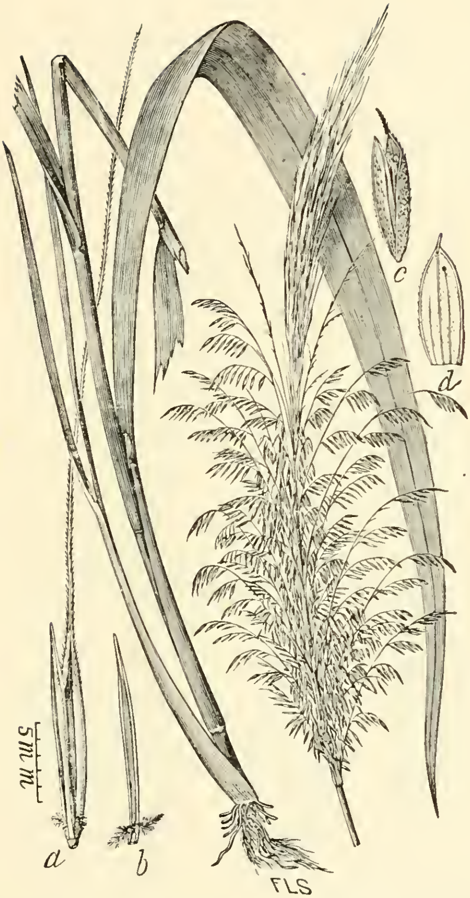

FIG. 409. **Zizania aquatica** Linn. Sp. Pl. 991. WILD RICE "REEDS."—A stout, erect, aquatic annual 9 to 30 dm. high, with broad, flat leaves and large panicles 30 to 60 cm. long. Staminate spikelets (*c*) 6 to 12 mm. long, awnless; the pistillate spikelets (*a*) 8 to 24 mm. long, the outer one bearing an awn 24 to 48 mm. long. Grain linear, 10 to 16 mm. long.—Swamps and shallow margins of sluggish streams and rivers, New Brunswick to Manitoba, southward to Florida and Texas. June-October.

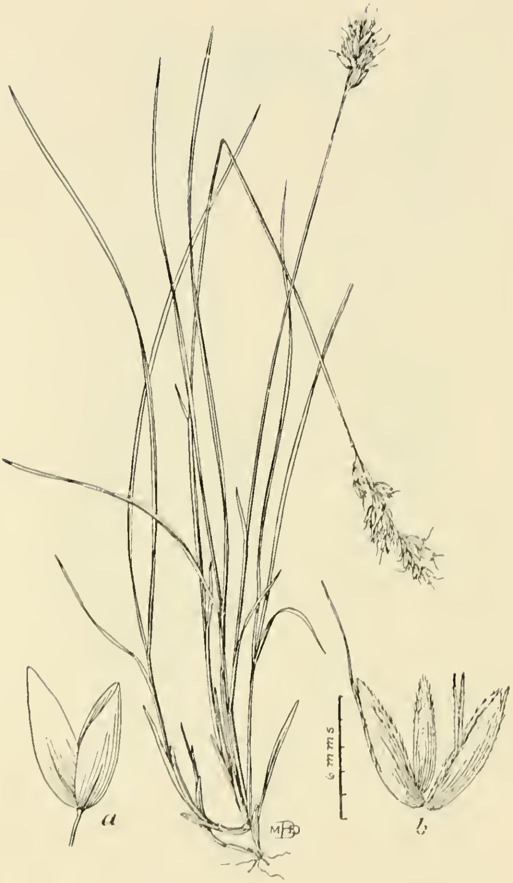

FIG. 410. **Savastana alpina** (Sw.) Scribn. Mem. Torr. Bot. Club, 5: 34. 1894. (*Holcus alpinus* Sw. *Hierochloa alpina* R. & S.) ALPINE HOLYGRASS.—A slender, glabrous, erect perennial 1.5 to 4.5 dm. high, with flat leaves and contracted panicles 1.5 to 3 cm. long. Spikelets 5 to 7 mm. long, with the awn of the fourth glume more or less bent and about 6 mm. long.—Greenland to Alaska and on the high mountains of New England and New York. [Northern Europe and Asia.] July, August.

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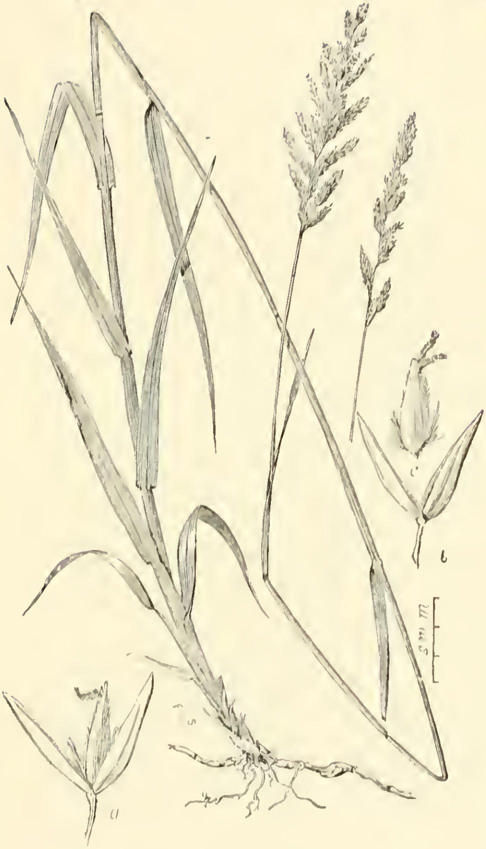

FIG. 411. **Phalaris arundinacea** Linn. Sp. Pl. 55. REED CANARY-GRASS.—A stout, erect, glabrous, broad-leafed perennial, 6 to 15 dm. high, with densely flowered panicles, 6 to 16 cm. long. Spikelets (*a*) 5 to 6 mm. long, with scabrous, 3-nerved outer glumes (*b*), one-fourth longer than the obtuse, pubescent flowering glume.—Moist places and in shallow water, Nova Scotia to British Columbia, and southward to Maryland, Tennessee, Kansas, Arizona, and California. [Europe, Asia.] June–September.

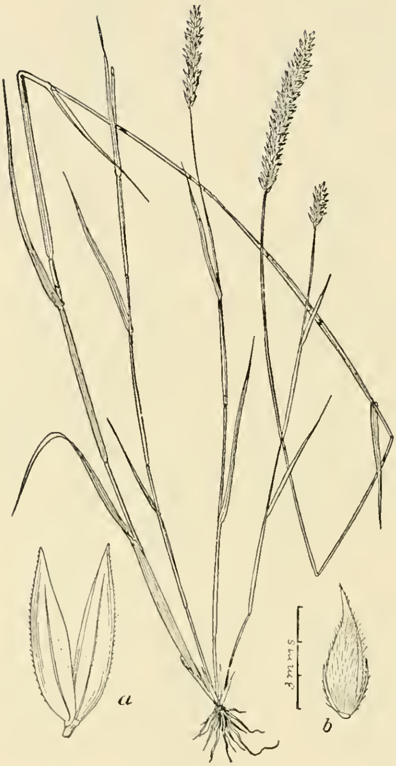

FIG. 412. **Phalaris lemmoni**, Vasey, Contrib. Nat. Herb. **3** : 42. 1892. LEMMON'S CANARY-GRASS.—A rather slender, erect perennial 4 to 10 dm. high, with short, flat leaves and spike-like, cylindrical panicles 4 to 6 cm. long. Spikelets 4 to 5 mm. long, with acute, wingless outer glumes (*a*) and lanceolate, acuminate, pubescent flowering glume (*b*) nearly as long as the outer ones.—California. June.

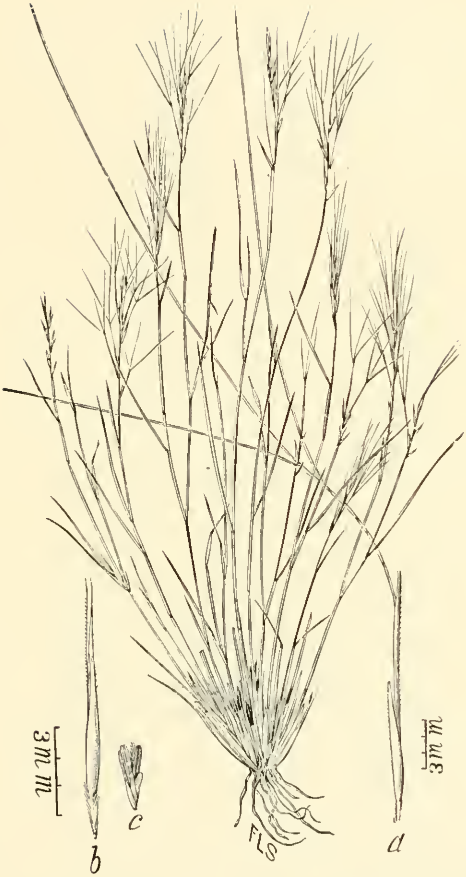

Fig. 413. **Aristida californica** Thurb. in Brewer & S. Wats. Bot. Calif. **2**: 289. 1880.—Hare's Grass.—A slender, densely tufted, pubescent perennial, with very narrow involute leaves and racemose, few-flowered panicles 2 to 4 cm. long. Outer glumes unequal; flowering glume shorter than the first glume. Awns slender, nearly equal, 3 to 4 cm. long, twisted below into a slender stipe, which is articulated with the flowering glume.—Dry, desert places, Arizona to southern and Lower California. May.

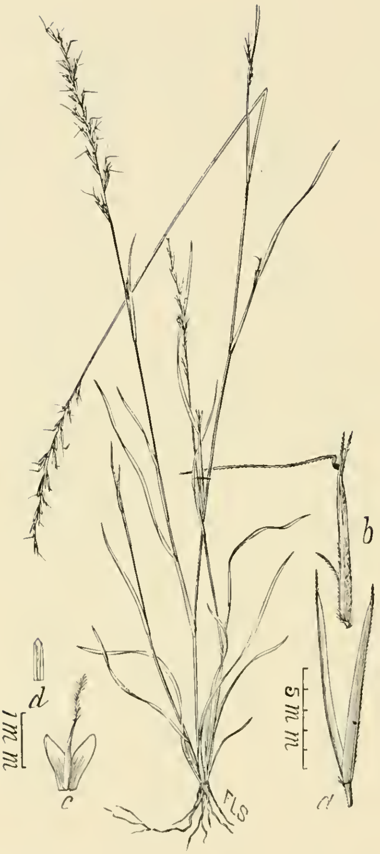

Fig. 414. **Aristida dichotoma** Michx. Flor. Bor. Am. 1 : 41. 1803. Poverty Grass.—A slender, erect, dichotomously branching annual 1.5 to 6 dm. high, with narrow, usually involute leaves and slender, spike-like racemes or simple panicles 4 to 10 cm. long. Spikelets about 6 mm. long, with nearly equal outer glumes and narrow, three-awned flowering glumes; lateral awns 2 mm. long or less, the middle awn coiled at the base, 5 to 8 mm. long.—Dry, sandy soil from Canada southward to Florida and westward to Ontario, Missouri, and Texas. August, September.

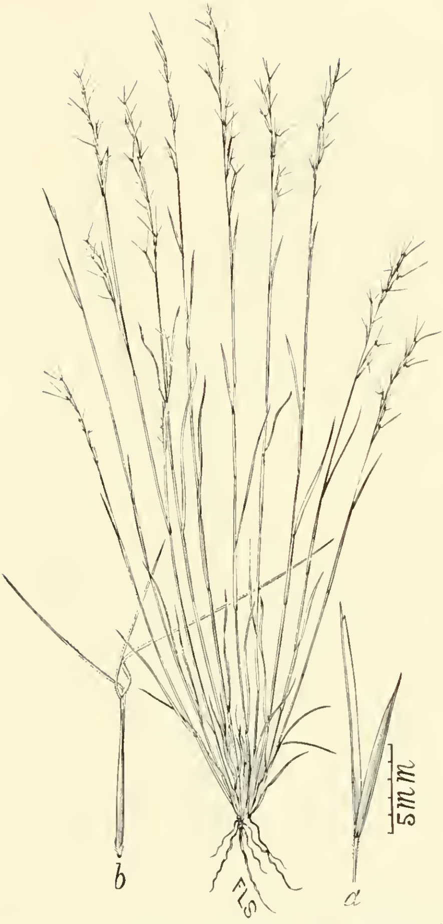

FIG. 415. **Aristida basiramea** Engelm.; Vasey, in Coulter Bot. Gaz. **9** : 76. 1884. TUFTED TRIPLE-AWN.—An erect, slender, smooth, much-branched perennial 1 to 4 dm. high, with narrow, involute-setaceous leaves, and few-flowered, spike-like panicles 6 to 10 dm. long. Empty glumes (*a*) unequal; middle awn 12 to 18 mm. long, coiled at the base and divergent.—Dry soil, Illinois and Manitoba, to Virginia and Kansas. August, September.

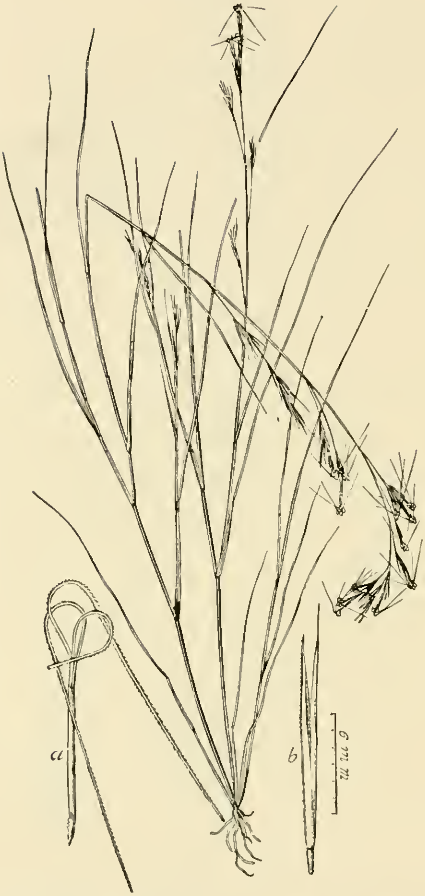

FIG. 416. **Aristida desmantha** Trin. & Rupr., Mém. Acad. St. Petersb. (VI), **5** : 199. 1842. WESTERN BUNCH-GRASS.—A slender, but rather rigid, erect, glabrous perennial 3 to 6 dm. high, with narrow, attenuate-pointed leaves and narrow panicles about 12 cm. long. Spikelets with the nearly equal outer glumes (*b*) about 12 mm. long, exceeding the flowering glume (*a*), which bears 3 nearly equal, reflexed, somewhat coiled awns about 24 mm. long.—Dry soil, Kansas (?), Indian Territory, and Texas. August.

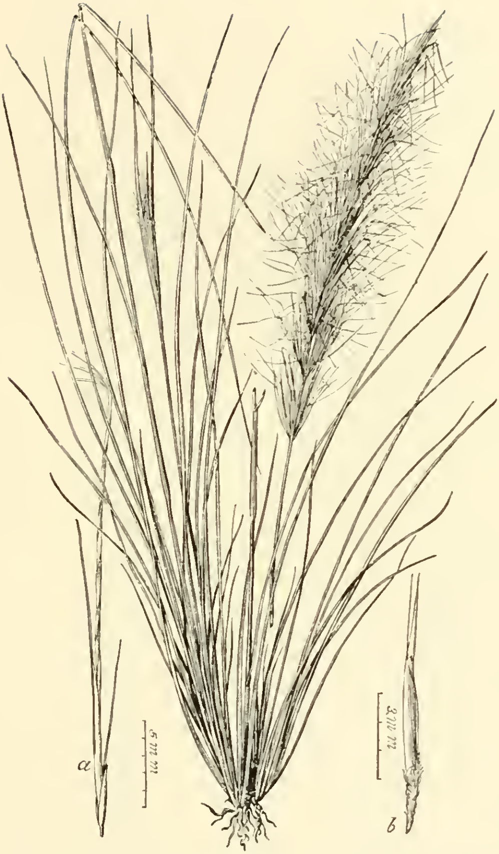

Fig. 417. **Aristida spiciformis** Ell. Bot. S. Car. & Ga. **1**: 141. 1817. Spike-like Poverty Grass.—A stout, erect perennial, 3 to 9 dm. high, with rather long, linear leaves and densely flowered, cylindrical, spike-like panicles. Outer glumes much shorter than the flowering one, which is twisted above to the spreading or divergent awns. The middle awn longer than the lateral ones.—Moist pine barrens, Georgia and Florida to Mississippi. July–October.

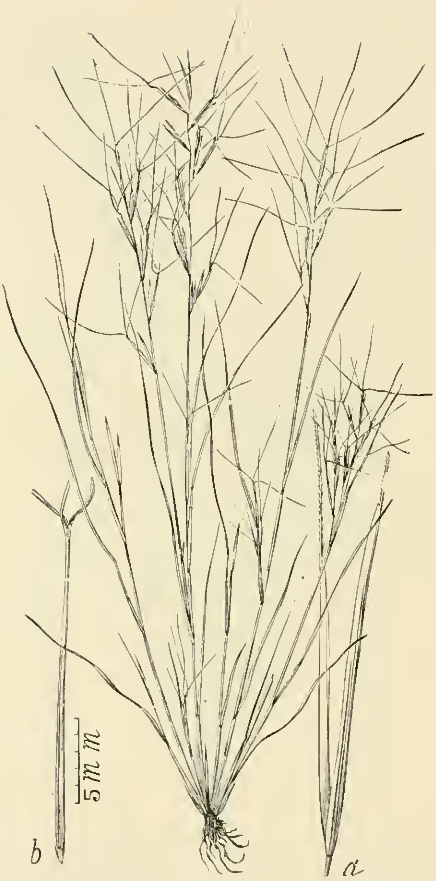

Fig. 418. **Aristida oligantha** Mx. Flor. Bor. Am. **1** : 41. 1803. Prairie Triple-awn.—A tufted, much-branched native annual, with slender stems 2 to 4 dm. high, loose sheaths, narrow leaves and lax, few-flowered panicles.—In poor, dry soil from the Middle States southward to Louisiana and Texas and also in Oregon and California. July–October.

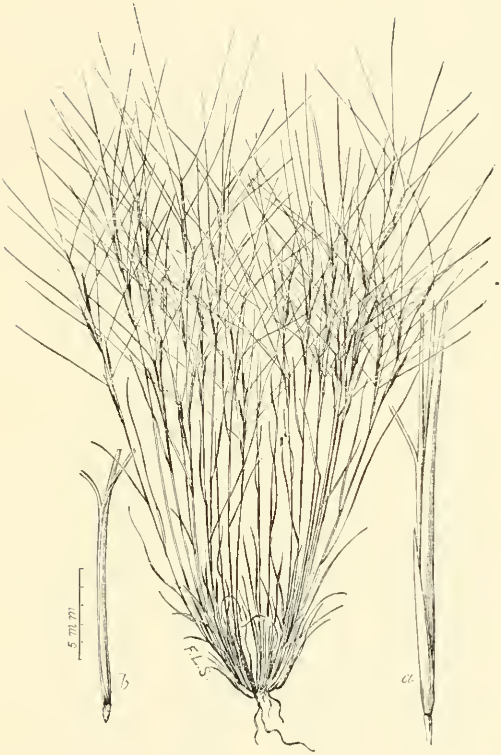

Fig. 419. **Aristida fasciculata** Torr. Ann. Lyc. N. Y. **2** : 154. 1826. Dog-town Grass.—A slender or sometimes rather stout, densely cæspitose, wiry perennial 2 to 4 dm. high, with narrow, rather rigid, involute leaves, and contracted, few-flowered panicles 5 to 12 cm. long. Spikelets usually purplish, with very unequal empty glumes, the first about one-half the length of the second, which is 14 to 24 mm. long; the flowering glume usually about 12 mm. long, terminated by three divergent, nearly equal awns varying in length from 2 to 10 cm.—Dry soil, Minnesota to Kansas and Texas, and westward to British Columbia and Arizona. April–September.

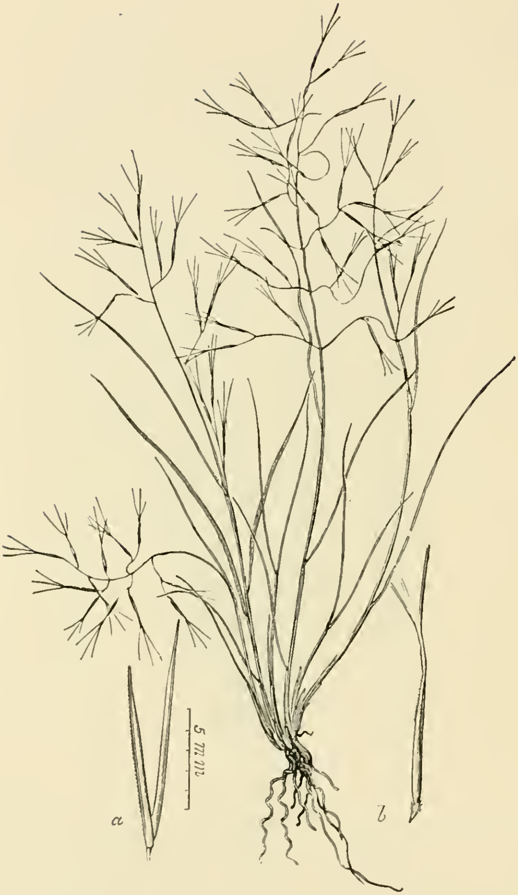

Fig. 420. **Aristida havardii** Vasey, Bull. Torr. Bot. Club, **13**: 27. 1886. Havard's Poverty Grass.—A slender, erect, branching perennial, usually about 3 dm. high, with setaceous leaves and divaricate-spreading, flexuous panicles 8 to 12 cm. long. Empty glumes (*a*), slightly unequal. Awns spreading, nearly equal, 12 to 14 mm. long.—Western Texas to New Mexico and Arizona. August-October.

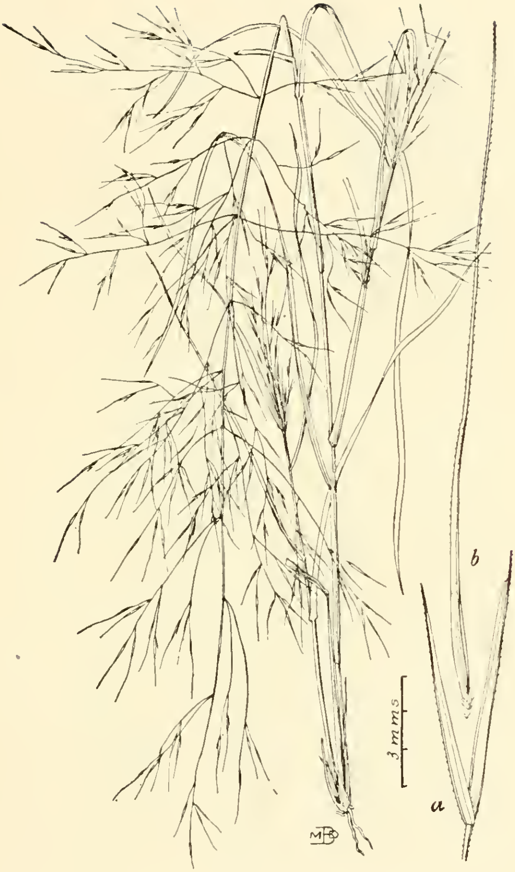

Fig. 421. **Aristida divergens** Vasey, Contrib. Nat. Herb., **3**: 48. 1892. Texas Poverty-grass.—A rather rigid, erect perennial, 3 to 6 dm. high, with narrow, involute leaves and diffuse panicles 10 to 16 cm. long. Second glume a little longer than the first (*a*), bristle-pointed, and slightly exceeding the flowering glume (*b*), which is 6 to 8 mm. long. Awn 10 to 12 mm. long, the lateral awns wanting or nearly so.—Arizona and Texas. August, September.

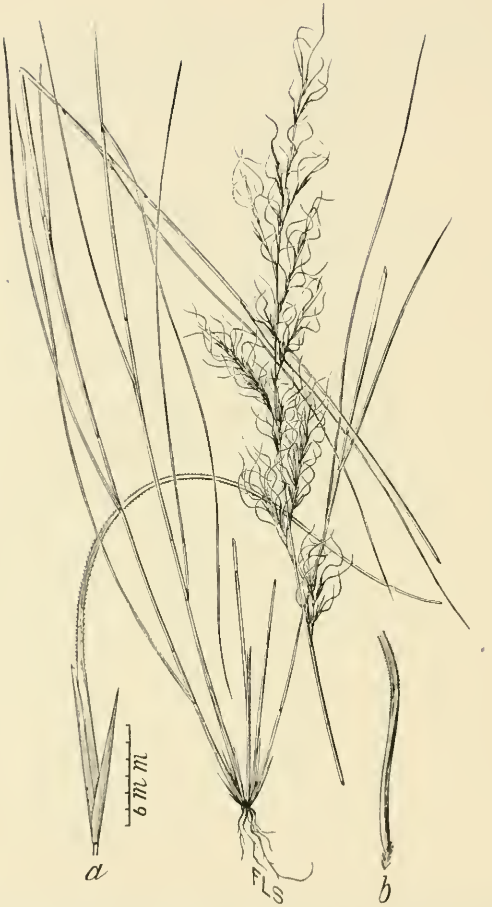

FIG. 422. **Aristida floridana** (Chapm.) Vasey. 1892. (*Streptachne floridana* Chapm. Fl. S. St. 554.) FLORIDA CURLY BEARD.—A slender, erect, somewhat wiry perennial, about 6 dm. high, with nearly filiform leaves and narrow panicles 30 cm. long. Spikelets (*a*) with nearly equal, purplish empty glumes and a strongly involute, linear flowering glume tapering into a long, more or less curved or flexuous awn; lateral awns wanting.—Florida. September.

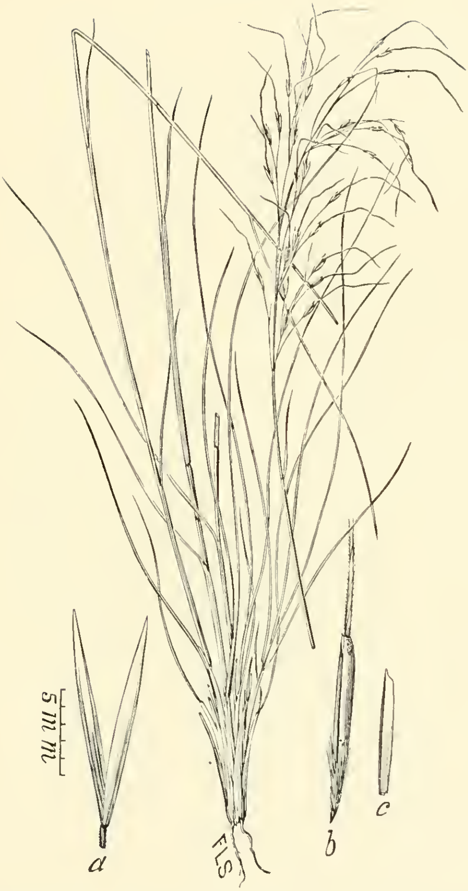

Fig. 423. **Stipa avenacea** Linn. Sp. Pl. 78. (*S. barbata* Michx.) Black Oat-grass.—A smooth, erect perennial 3 to 7.5 pm. high, with involute, filiform leaves and open, few-flowered panicles 10 to 16 cm. long. Spikelets 8 to 10 mm. long. Awn 3 to 5 cm. long.—Dry open woodlands, etc., Rhode Island to Ontario and Wisconsin and southward to Florida and Mississippi. April–July.

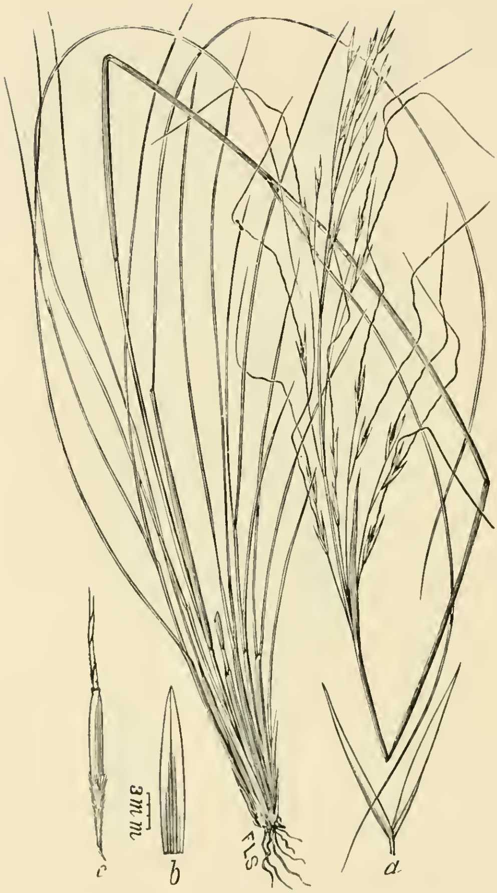

FIG. 424. **Stipa avenaceoides** Nash, Bull. Torr. Bot. Club, **22**: 423. 1895. FEATHER GRASS.—A rather slender, erect, smooth perennial, 6 to 12 dm. high, with long involute-setaceous leaves and simple panicles 8 to 20 cm. long. Spikelets few, with acuminate empty glumes (*a*), 16 to 20 mm. in length; flowering glumes (*b*), including the callus, 14 to 16 mm. long. Awn 6 to 8 cm. long, pubescent below, twice geniculate.—Florida in pine lands, near Cassia, Lake County. March-July.

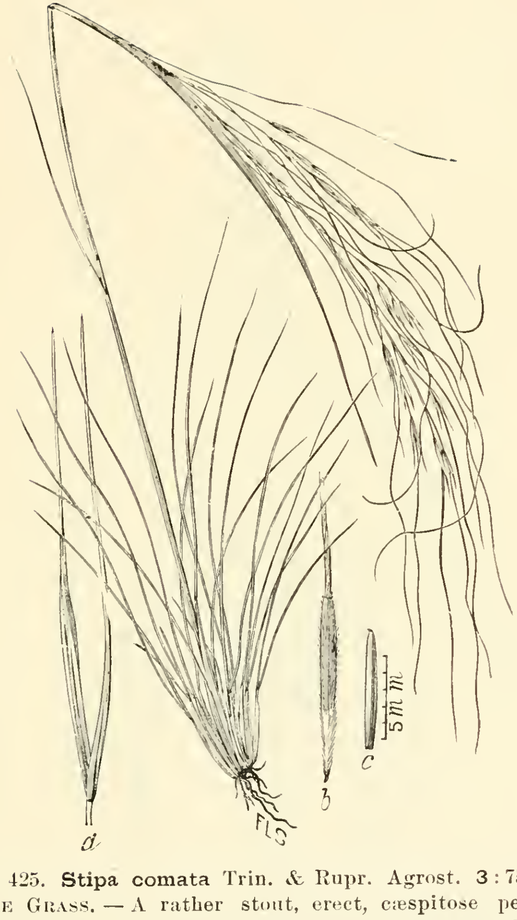

FIG. 425. **Stipa comata** Trin. & Rupr. Agrost. **3**:75. 1842. NEEDLE GRASS. — A rather stout, erect, cæspitose perennial 3 to 9 dm. high, with mostly involute leaves and loosely-flowered panicles 16 to 24 cm. long. Spikelets with nearly equal long-attenuate-pointed empty glumes (*a*) about 24 mm. long, and thinly pubescent flowering glumes (*b*) about 12 mm. long. Awn slender, 8 to 10 cm. long, strongly flexuous or variously curled and twisted.—Dry sandy soil, British Columbia to California and eastward to the Dakotas and Nebraska. May-September.

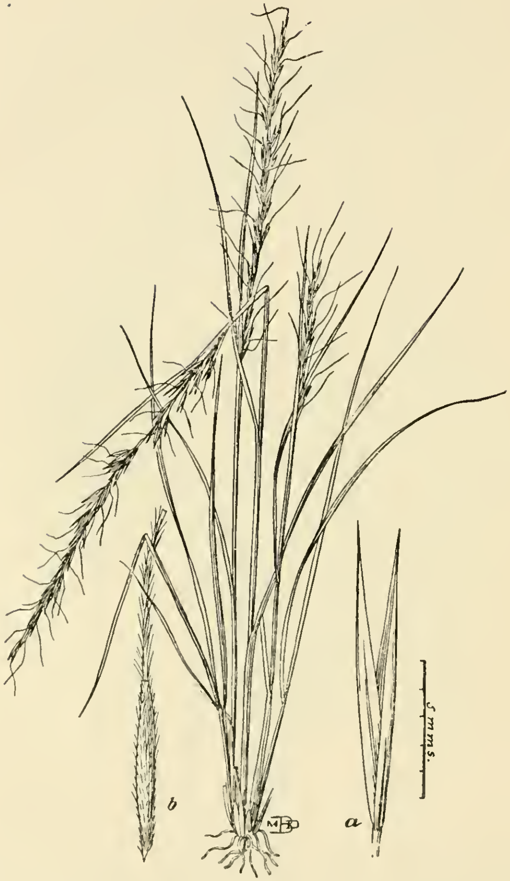

FIG. 426. **Stipa oregonensis** Scribn. new name. (*S. stricta* Vasey, not Lam.) NARROW-TOPPED FEATHER-GRASS.—A slender, erect, tufted perennial 3 to 5 dm. high, with narrow, setaceously pointed leaves and contracted, erect panicles 8 to 16 cm. long. Empty glumes (*a*) 10 mm. long, exceeding the thinly pubescent flowering glumes. Awn 24 to 36 mm. long, pubescent or subplumose in the lower half.—Oregon and Washington.

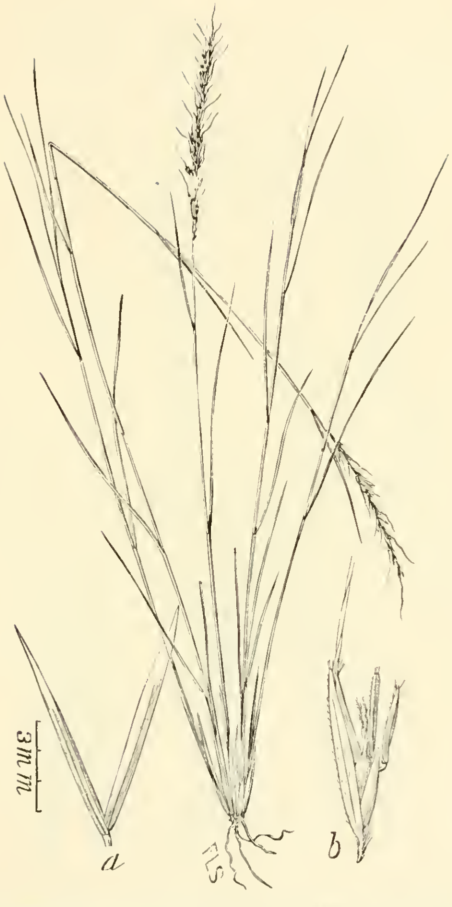

Fig. 427. **Stipa hassei** Vasey, Contrib. Nat. Herb. **1**: 267. 1893. Hasse's Feather-grass.—A slender, wiry, and densely tufted perennial, 3 to 4.5 dm. high, with narrow, almost thread-like, erect leaves and narrow panicles 4 to 6 cm. long. Spikelets about 6 mm. long, with narrowly lanceolate, nearly equal, acute empty glumes (*a*) which slightly exceed the smooth flowering glume. Awn 16 to 18 mm. long, smooth.—Dry soil, ridges, etc., southern California. April.

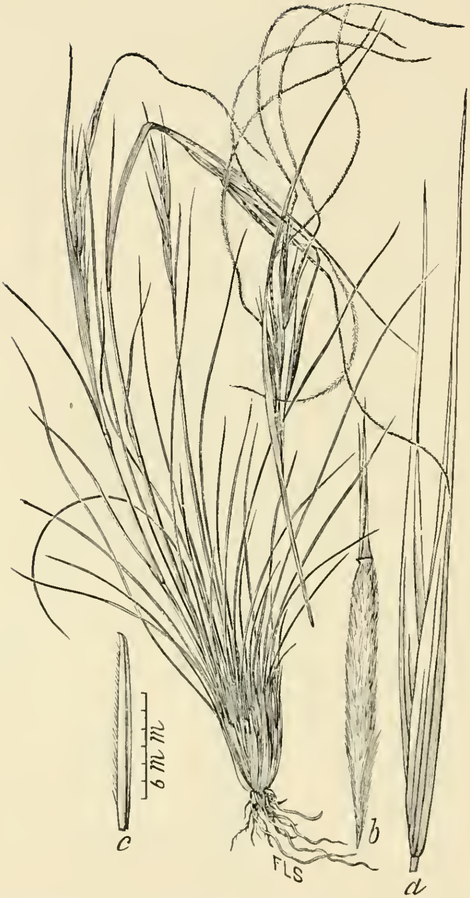

Fig. 128. **Stipa neo-mexicana** (Thurber). new comb. (*S. pennata neo-mexicana* Thurber in Vasey, Ill. N. Amer. Grasses (2^2: No. 8, 1891.) New Mexican Feather-grass.—A rather stout, erect, densely tufted perennial 3 to 9 dm. high, with involute leaves and narrow, racemose panicles 8 to 10 cm. long. Awns 8 to 12 cm. long, feather-plumose excepting near the base.—High northern slopes of the mountains of southern Colorado, New Mexico, Arizona, and Texas. May–September. Ornamental.

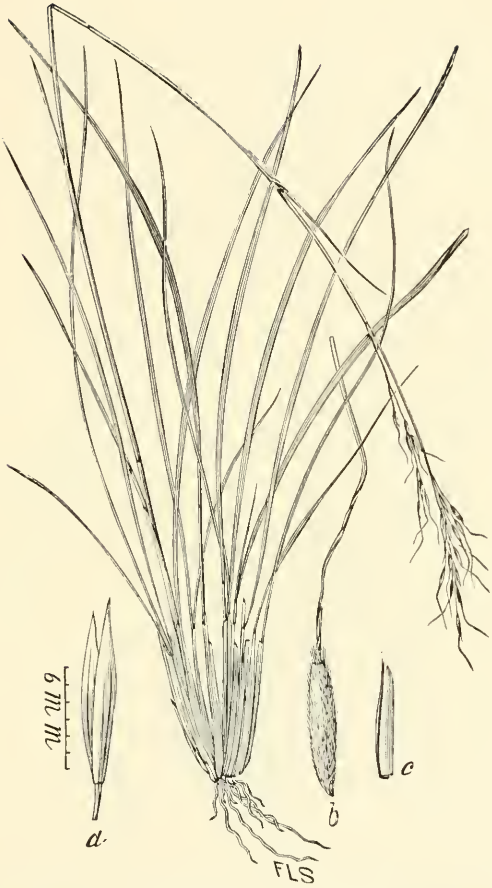

FIG. 429. **Stipa pringlei** Scribn. Contrib. Nat. Herb. **3**: 54. 1892. (*Oryzopsis pringlei* Beal.) PRINGLE'S FEATHER-GRASS.—A slender, erect, cæspitose perennial 6 to 12 dm. high, with long, flat leaves and loosely few-flowered panicles 15 to 20 cm. long. Spikelets 8 to 10 mm. long, with acute, 5-nerved empty glumes (*a*), and pubescent flowering glumes (*b*). Awn slender, about 20 mm. long.—Dry slopes, Texas, to Arizona and California. [Mexico.] July-October.

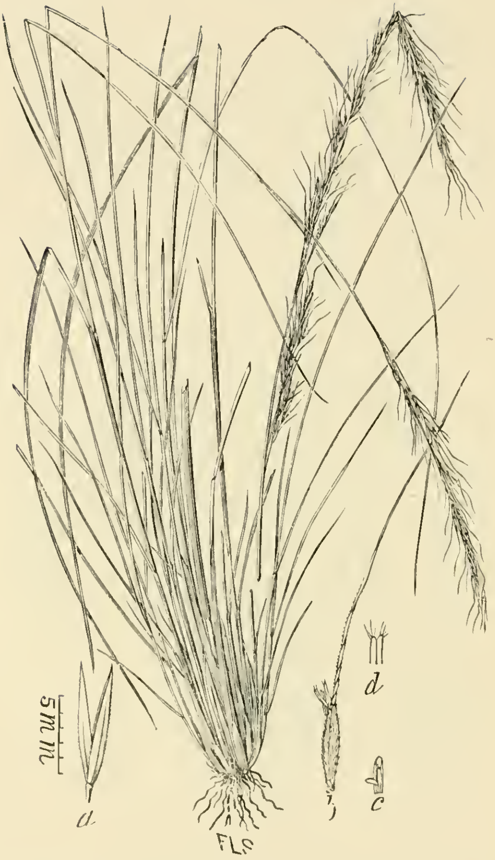

Fig. 430. **Stipa viridula** Trin. Mem. Acad. St. Petersb. (VI.) **2**: 39. 1836. Feather Bunch-grass.—A slender or rather stout, cæspitose, erect perennial 5 to 10 dm. high, with involute-pointed leaves and narrow, contracted panicles 12 to 20 cm. long. Spikelets with nearly equal, subulate pointed empty glumes 6 to 9 mm. long, and hairy or pilose flowering glume, which is about 5 mm. long and has a short, obtuse callus. Awn about 24 mm. long, finally separating from the glume.—Colorado to Montana and westward.

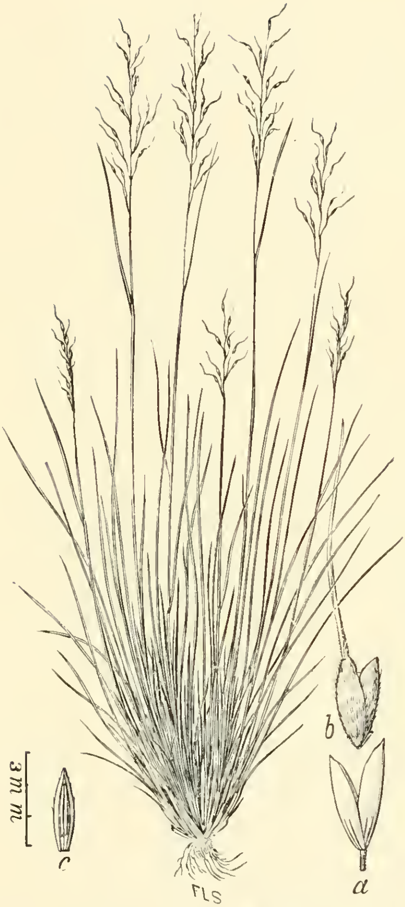

Fig. 431. **Stipa macounii** Scribn. Macoun Cat. Can. Pl. **5**: 390. 1890. (*S. richardsonii* A. Gray, 1856, not Link, 1833.) Macoun's Stipa.—A slender, densely cæspitose perennial 3 to 6 dm. high, with very narrow leaves and few-flowered panicles 4 to 10 cm. long. Empty glumes (*a*) about 4 mm. long, the pubescent flowering glumes a little shorter than the empty ones. Awn, 8 to 10 mm. long.—Maine to Lake Superior and northward. July–August.

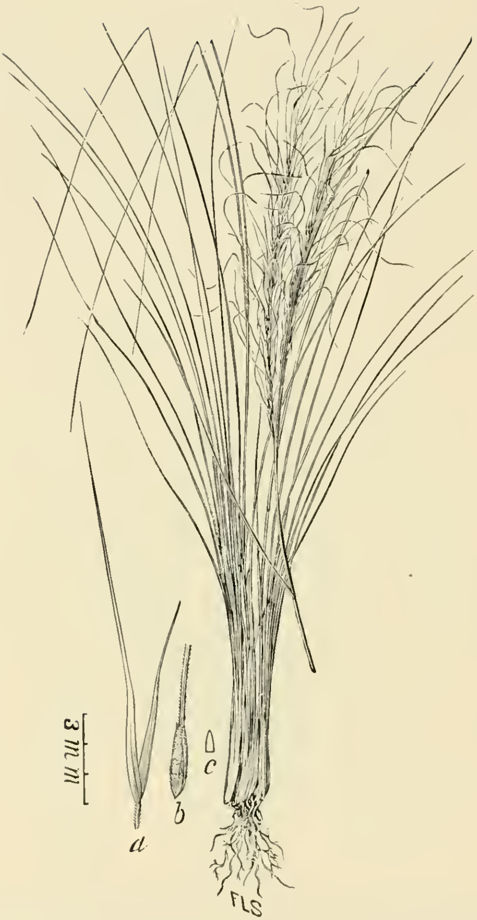

FIG. 432. **Stipa tenuissima** Trin. Mem. Acad. St. Petersb. (VI.) **2**: 36. 1836. SLENDER FEATHER-GRASS.—A slender, densely-tufted perennial 5 to 8 dm. high, with long, filiform leaves and narrow panicles 15 to 20 cm. long. Empty glumes (*a*), subulate-pointed, the first 12 to 18 mm., the second 5 to 8 mm. long; flowering glume (*b*) about 2.5 mm. long. Awn flexuous, 7 to 8 cm. long.—Limestone hills, etc., Texas and New Mexico. [Mexico.] August, September.

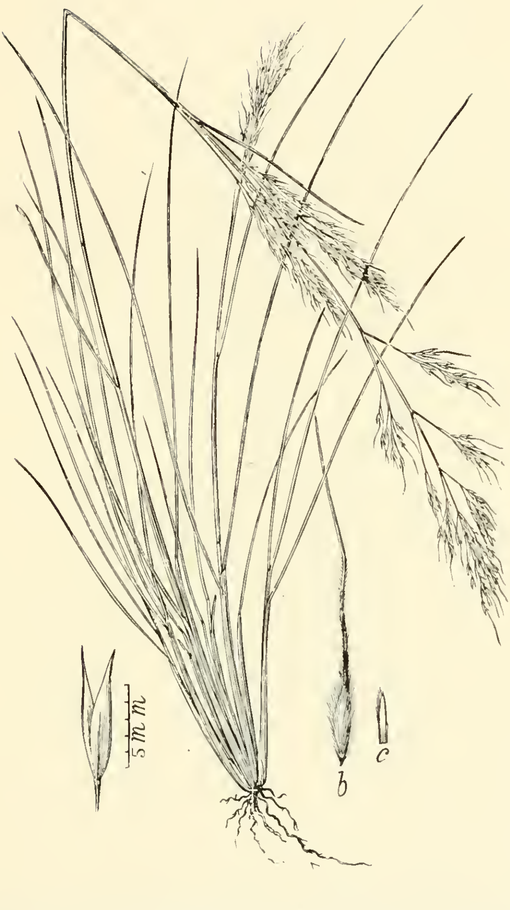

FIG. 433. **Stipa bloomeri** Boland. Proc. Calif. Acad. Sci. **4**: 168. 1870. (*S. sibirica* Thurb., not Lam.) BLOOMER'S STIPA.—A slender, densely cæspitose perennial 3 to 9 dm. high, with long, narrow or involute leaves and more or less open panicles 12 to 24 cm. long. Spikelets 8 mm. long, empty glumes (*a*) acute, one-fourth longer than the hairy flowering glume (*b*). Awn 12 to 18 mm. long.—California and Montana.

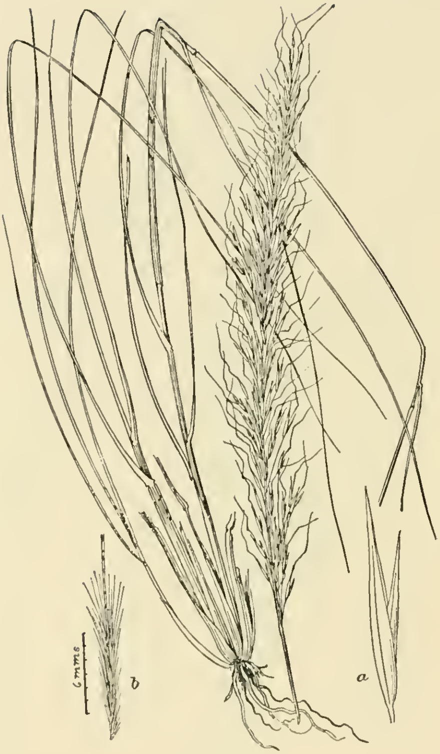

Fig. 434. **Stipa coronata** Thurber, in Brewer & S. Wats. Bot. Calif. **2** : 287. 1880. Crested Feather-grass.—A stout, erect perennial 12 to 18 dm. high, with flat leaves, the lower ones often 9 dm. long, and erect, narrow, and rather densely flowered panicles 3 to 4 dm. long. Spikelets with unequal, acuminate-pointed empty glumes (*a*), the lower one about 16 mm. long, and silky-hairy flowering glumes (*b*), which have a crown of longer (4 mm.) hairs. Awn slender, about 2 cm. long.—Sandy plains and hillsides, Arizona and California. March–September.

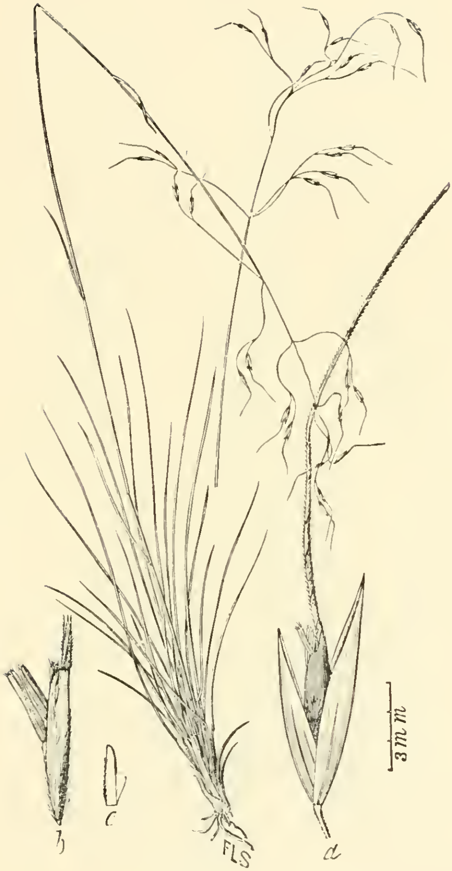

Fig. 435. **Stipa richardsoni** Link, Hort. Berol. **2** . 245. 1833. Richardson's Feather-grass.—A slender, erect perennial 6 to 9 dm. high, with narrow leaves, and nodding, open, few-flowered panicles 7 to 12 cm. long. Spikelets (*a*) 8 to 9 mm. long, the broadly lanceolate, acute empty glumes exceeding the thinly hairy flowering glume (*b*). Awn slender, scabrous, 12 to 20 mm. long.—Dry hillsides and open woods, South Dakota, Colorado, Wyoming, Montana, and Canada. July–September.

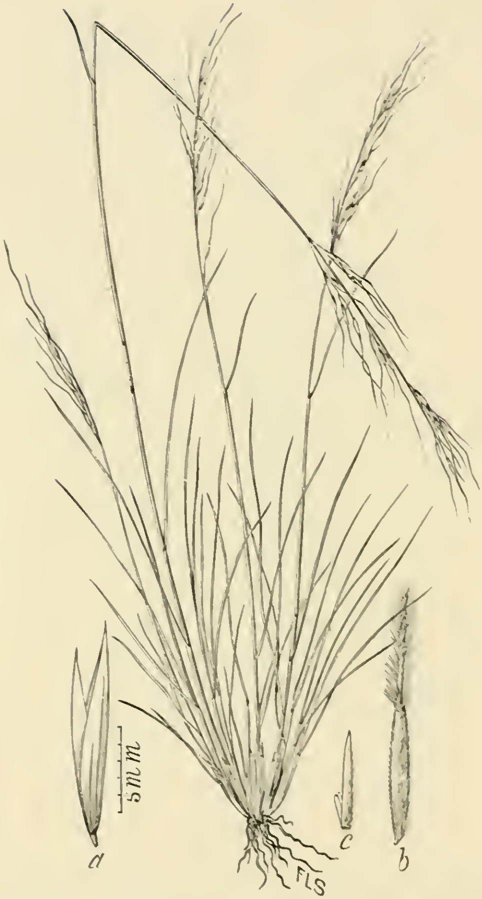

FIG. 436. **Stipa occidentalis** Thurb. Bot. Wilkes Exped. 483. 1874. WESTERN NEEDLE-GRASS.—A slender, erect perennial 3 to 6 dm. high, with rigid, involute leaves and contracted panicles 6 to 12 cm. long. Spikelets about 10 mm. long, flowering glumes (*b*) pubescent, 6 to 7 mm. long. Awn 3 cm. long, plumose below.—Dry soil and rocky banks of the plains and foot-hills, Nevada, California, Oregon, and Washington. May-July.

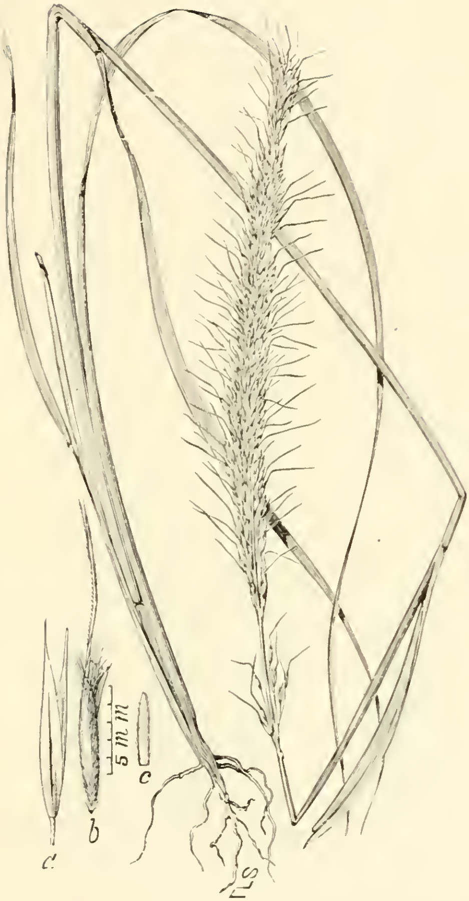

FIG. 437. **Stipa vaseyi** Scribn. U. S. Dept. Agr. Div. Agros. Bull. **11**: 46. 1898. (*Stipa viridula* var. *robusta* Vasey; not *Stipa robusta* Nutt.) SLEEPY GRASS.—A stout, erect perennial 12 to 18 dm. high, with long, flat leaves and erect, densely flowered panicles 30 to 45 cm. long. Spikelets about 10 mm. long, with pubescent flowering glumes (*b*) 6 to 7 mm. long. Awn slender, about 26 mm. long.—Colorado, New Mexico, southern California. [Mexico.] June–September.

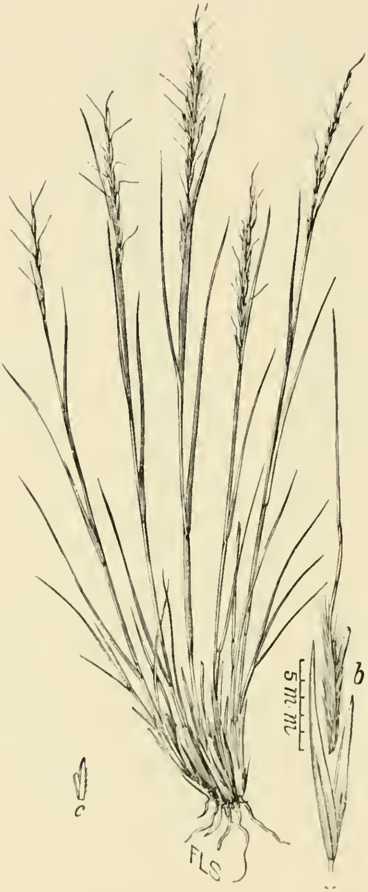

Fig. 438. **Stipa scribneri** Vasey, Bull. Torr. Bot. Club, **11**: 125. 1884. Scribner's Feather-grass.—A stout, erect, smooth perennial 4.5 to 7.5 dm. high, with rather long, narrow, involute-pointed leaves and contracted panicles 12 to 16 cm. long. Spikelets 12 to 14 mm. long, with pubescent flowering glumes (*b*) which are 6 to 10 mm. long and crowned with a tuft of rather long hairs.—Dry soil of mesas and canyons, Colorado and New Mexico. June–September.

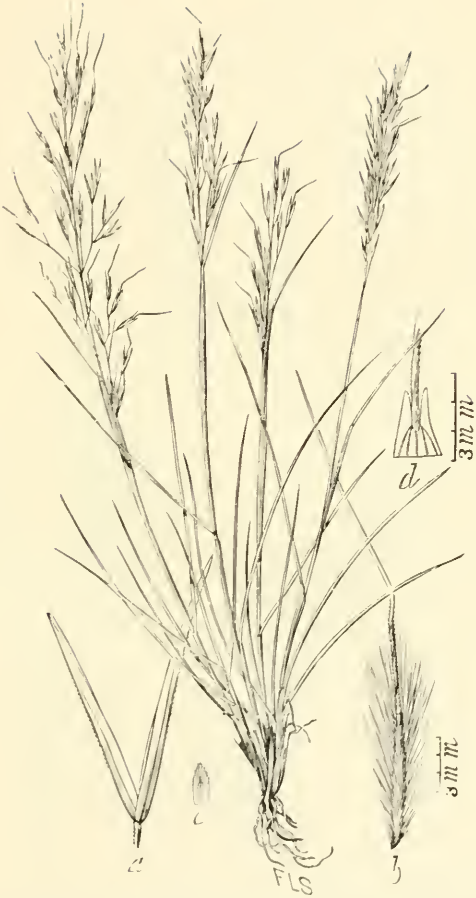

FIG. 439. **Stipa parishii** Vasey, Coult. Bot. Gaz. **7**: 32. 1882. PARISH'S FEATHER-GRASS.—A rather stout, erect, tufted perennial 3 to 4.5 dm. high, with rigid, involute leaves and open, erect panicles about 15 cm. long. Spikelets 12 to 14 mm. long, with flowering glumes (*b*) densely covered with long, silky hairs. Awn about 18 mm. long.—Dry soil, mountains of southern and Lower California. June–August.

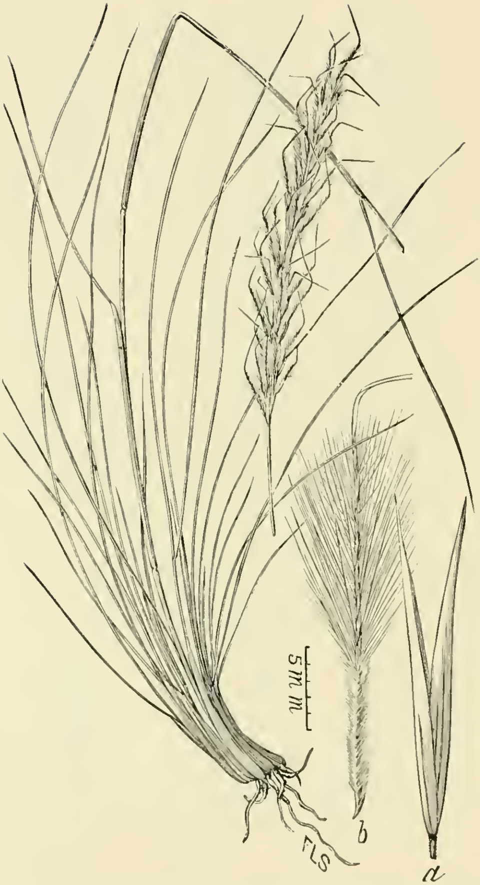

FIG. 440. **Stipa speciosa** Trin. & Rupr. Sp. Gram. Stip. 45. 1842. SHOWY FEATHER-GRASS.—A rather stout, erect, cæspitose perennial 3 to 6 dm. high, with long, narrow, radical leaves and erect, contracted panicles 12 to 16 cm. long. Spikelets 16 to 18 mm. long, with silky-pubescent flowering glumes (*b*) 10 to 12 mm. long. Awn 3 to 4 cm. long, plumose below the middle.—Dry soil, Colorado and Arizona to southern and Lower California. [South America.] April–September.

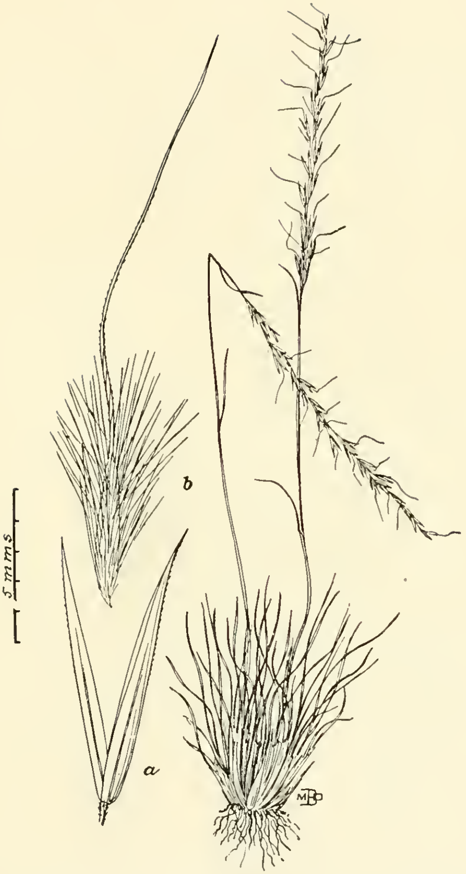

FIG. 441. **Oryzopsis webberi** (Thurb.) Vasey, Bull. Torr. Bot. Club, **15** : 49. 1888. (*Eriocoma webberi* Thurb. in Brewer & S. Wats. Bot. Calif. **2** : 283. 1880).—A slender, wiry, and densely tufted perennial 1 to 2 dm. high, with rigid, pungent-pointed, convolute leaves, and narrow, few-flowered panicles, 2 to 5 cm. long. Spikelets about 8 mm. long with acuminate empty glumes, and awned flowering glumes which are densely clothed with white, silky hairs. Awn very slender, about 4 mm. long.—California.

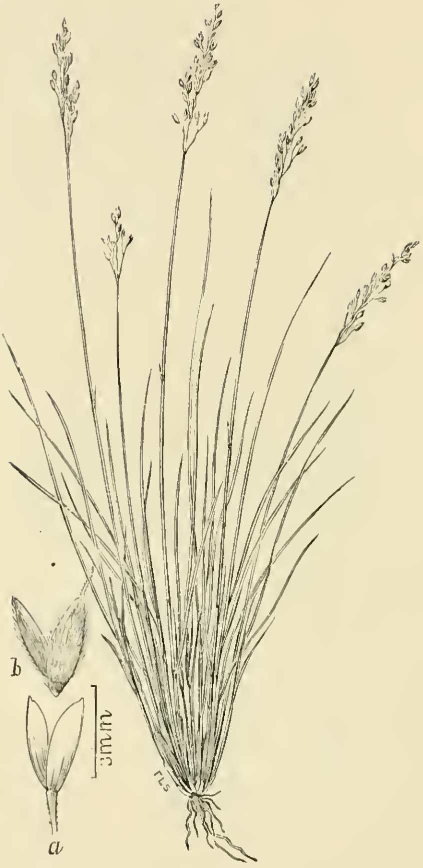

FIG. 442. **Oryzopsis juncea** (Mx.) B. S. P. Prel. Cat. N. Y. 67. 1888. (*Stipa juncea* Mx.; *Oryzopsis canadensis* Torr.) SMALL MOUNTAIN RICE.—An erect, glabrous, slender, tufted perennial 1.5 to 6 dm. high, with erect, involute leaves and narrow panicles 2 to 5 cm. long. Spikelets 3 to 4 mm. long, with pubescent flowering glumes which bear a slender, deciduous awn 1 to 2 mm. long.—Dry, rocky soil and open woodlands, Maine to British Columbia southward to Pennsylvania and Colorado. May–August.

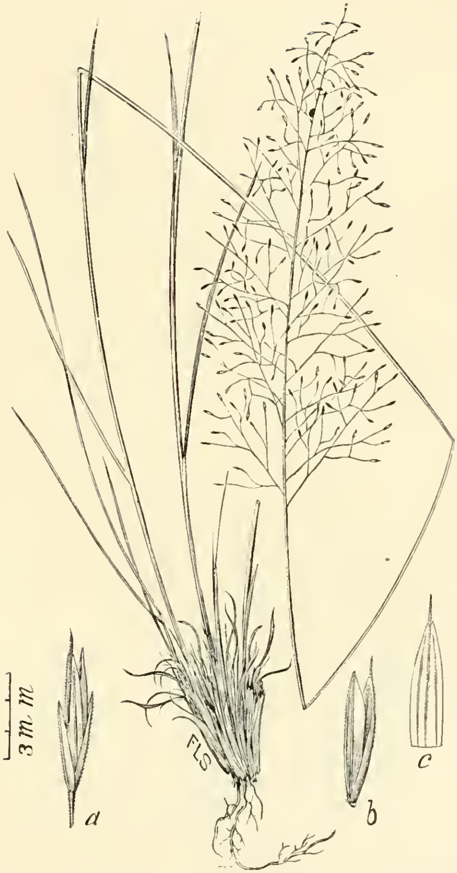

Fig. 443. **Muhlenbergia trichopodes** (Ell.) Chapm. Fl. S. U. S. 553. 1860. (*Agrostis trichopodes* Ell.) Bunch Hair-grass.—A slender, rather rigid perennial, 6 to 9 dm. high, with very narrow, involute leaves and capillary panicles nearly 30 cm. long. Spikelets (*a*) with nearly equal empty glumes which are hardly more than half the length of flowering glume (*c*), which is terminated by a short, straight awn.—Dry pine barrens, North Carolina to Florida and westward to Texas. July–October.

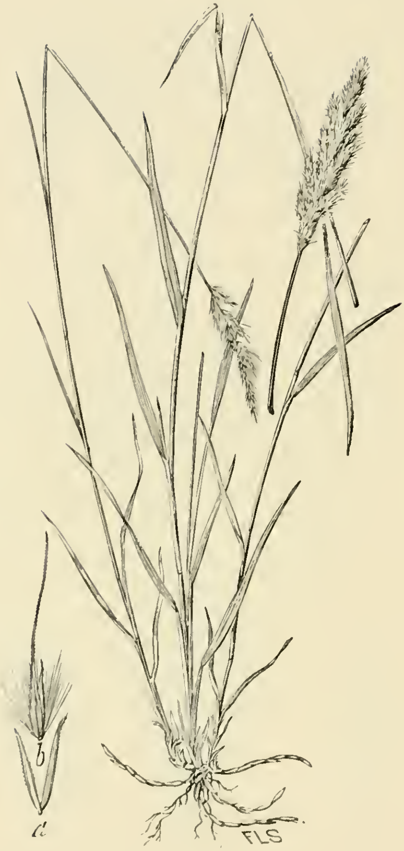

FIG. 411. **Muhlenbergia comata** (Thurb.) Benth.; Jour. Linn. Soc. **19** : 83. 1881. (*Vaseya comata* Thurb. Proc. Acad. Nat. Sci. Phila, 1863. 79. WOOLLY DROP-SEED.—A rather stout or slender, upright perennial, 3 to 9 dm. high, with flat leaves and densely flowered, more or less lobed, or interrupted panicles, 6 to 8 cm. long. Spikelets about 3 mm. long, with densely silky-hairy flowering glumes (*b*).—Rather moist, broken ground, in mountains and foothills, Nebraska to Oregon, south to Colorado and California. July-September.

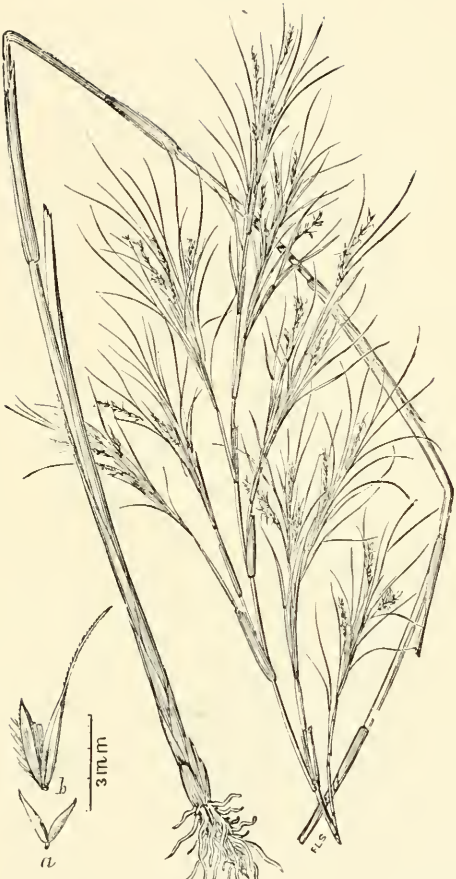

FIG. 445. **Muhlenbergia dumosa** Scribn. in Vasey, Contrib. Nat. Herb. **3**:71. 1892. (*Sporobolus depauperatus* (?) Scribn. in Bull. Torr. Bot. Club. **9**: 103. 1882.) SHRUBBY DROP-SEED.—A stout, woody, much-branched and leafy perennial, with erect or ascending culms 6 to 9 or 12 dm. long, and slender, simple panicles 1 to 3 cm. long. Spikelets about 3 mm. long with short-awned flowering glumes.—Rocky canyons and along streams in the mountains of Arizona. [Mexico]. May, June.

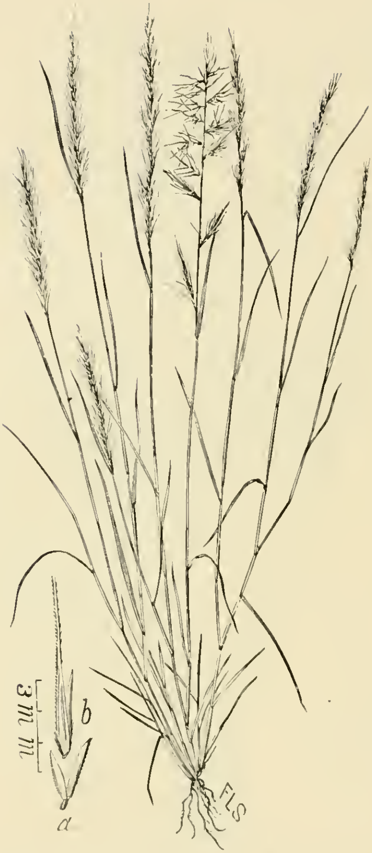

FIG. 446. **Muhlenbergia monticola** Buckley, Proc. Acad. Nat. Sci. Phila. 1862, 91.—A slender, wiry, much-branched perennial 3 to 6 dm. high, with short, narrow leaves and strict (or in anthesis spreading) panicles 8 to 20 cm. long. Spikelets with unequal empty glumes, the longer second one 2 mm. long and usually obtuse or toothed at the apex; the narrow flowering glume is 3 mm. long, pilose near the base and tipped with a very slender flexuose awn 10 to 15 mm. long.—Dry soil, Texas to Arizona. [Mexico]. August–October.

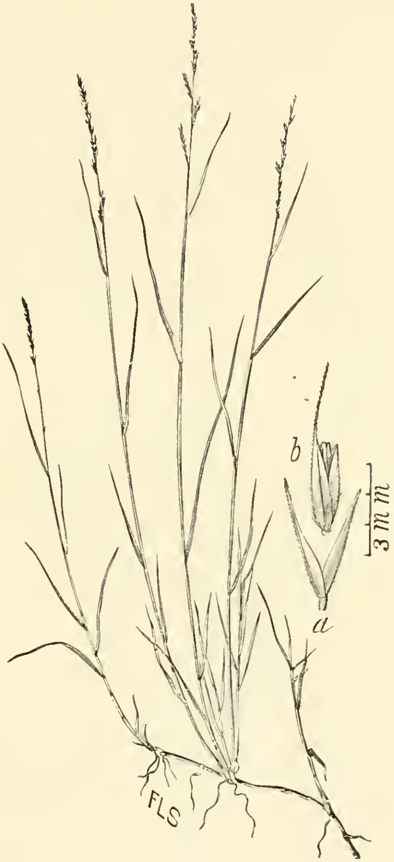

FIG. 417. **Muhlenbergia lemmoni** Scribn. Contrib. Nat. Herb. **13** : 70. 1892. LEMMON'S DROP-SEED.—A leafy, ascending, wiry perennial 3 to 6 dm. high, much branched at the base, with narrow, densely flowered, interrupted panicles 6 to 8 cm. long. Spikelets about 4 mm. long, with lanceolate-acuminate empty glumes (*a*), and broadly lanceolate, short-awned flowering glumes which are densely pubescent below.—Mountains, Texas to Arizona. September.

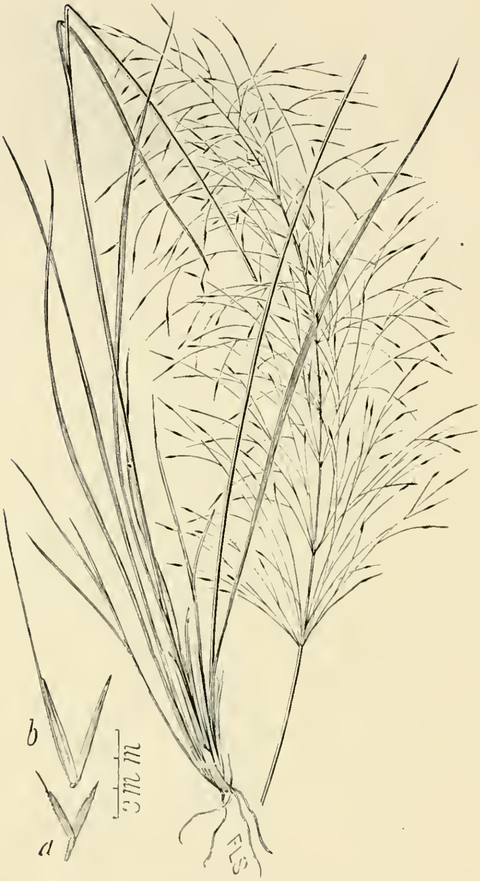

Fig. 448. **Muhlenbergia capillaris** Trin. Unifl. 191. 1824. (*Stipa capillaris* Lam. 1791.) Bearded Hair-grass.—A rigid, erect, glabrous, and unbranched perennial 6 to 10 dm. high, with long, involute leaves and showy, capillary panicles 15 to 45 cm. long. Spikelets about 4 mm. long, with nearly equal empty glumes and smooth flowering glume which bears a slender awn 6 to 18 mm. long.—Dry, sandy, or rocky soil, open woods, etc., Massachusetts to Florida and westward to Texas. August-October.

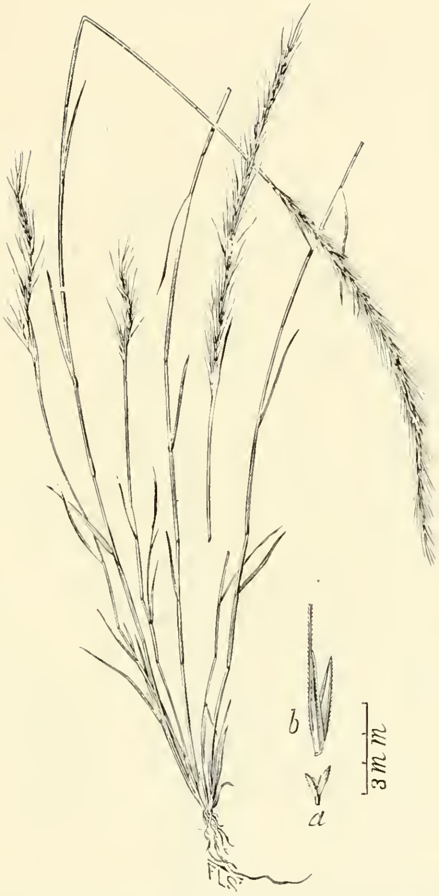

FIG. 449. **Muhlenbergia parviglumis** Vasey, Contrib. Nat. Herb. **3** : 71. 1892. SMALL-GLUMED DROP-SEED.—A slender, erect perennial 3 to 6 dm. high, often branching, with rather rigid, narrow leaves and narrow panicles 8 to 14 cm. long. Spikelets about 3 mm. long, with minute, nearly equal and obtuse empty glumes (*a*), one-fourth to one-fifth as long as the narrow, sharply two-toothed flowering glume, which bears a slender awn between the teeth 12 to 20 mm. long.—Texas. September, October.

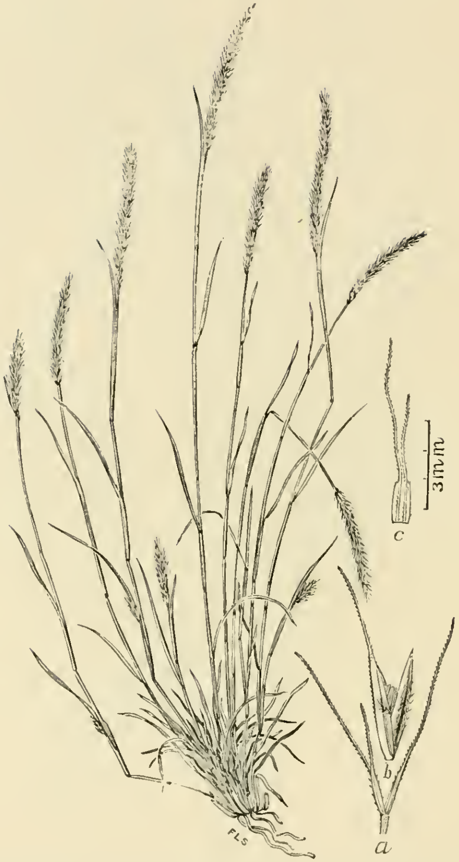

Fig. 450. **Lycurus phleoides** HBK. Nov. Gen. **1**: 142, t. 45. 1815. Texan Timothy.—A slender and somewhat wiry perennial 2 to 4.5 dm. high. much branched and often geniculate at the base, with narrow, long-pointed leaves and cylindrical, spike-like panicles 3 to 6 cm. long. Spikelets 4 mm. long, with awned glumes, the first glume (*C*) often terminating in two unequal awns, the flowering glume terminating in an awn as long as itself.—Dry soil on the plains and mesas, Colorado to Texas and westward to New Mexico and Arizona. [Mexico.] May–October.

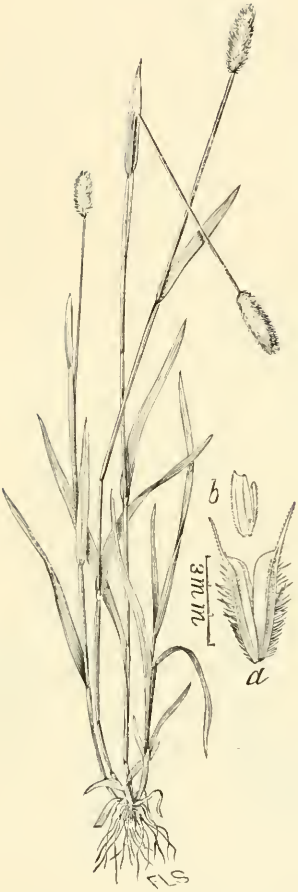

Fig. 451. **Phleum alpinum** Linn. Sp. Pl. 59. Alpine Timothy.—A glabrous, erect perennial, 1.5 to 4.5 dm. high, with flat leaves and cylindrical, ovoid, or oblong, spike-like panicles 1 to 5 cm. long. Empty glumes (*a*) short-awned 3 to 4 mm. long.—Moist soil in the mountains, Labrador to Alaska, south to New England, Arizona, and California. [Europe, Asia, South America.] June–September.

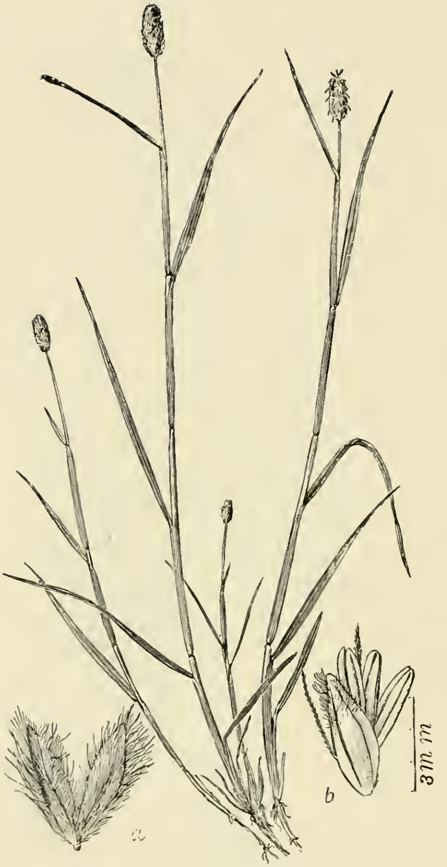

FIG. 452. **Alopecurus alpinus** J. E. Smith, Engl. Bot. pl. 1126. 1803. ALPINE FOXTAIL.—A glabrous, erect perennial 1 to 6 dm. high, with flat leaves and cylindrical, ovoid, densely-flowered panicles 1 to 3 cm. long. Spikelets 4 mm. long, with obtuse, densely villous outer glumes (*a*) about the length of flowering glume, which is pubescent near the apex, glabrous below, and bears upon the back, just below the middle, a slender awn a little exceeding the glumes.—Moist places, Greenland, Labrador to Alaska. [Arctic regions of Europe and Asia.] July, August.

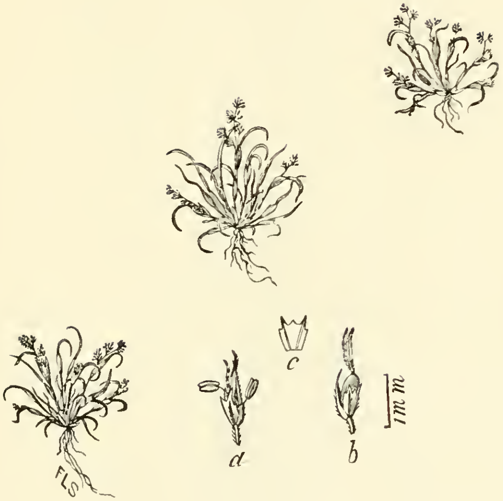

FIG. 453. **Coleanthus subtilis** Seid. litt. R. & S. Syst. **2**:276. 1817. (*Schmidtia utriculosa* Sternb. 1819; *S. subtilis* Tratt.) MOSS-GRASS.—A low, moss-like grass growing in loose tufts 2 to 6 cm. high, with short, recurved leaves, inflated sheaths, and simple panicles 1 to 2 cm. long. Spikelets (*a*, *b*) hardly 1 mm. long, in small, umbellate clusters.—Wet, muddy places, Washington and Oregon. [Northern Europe.] September, October.

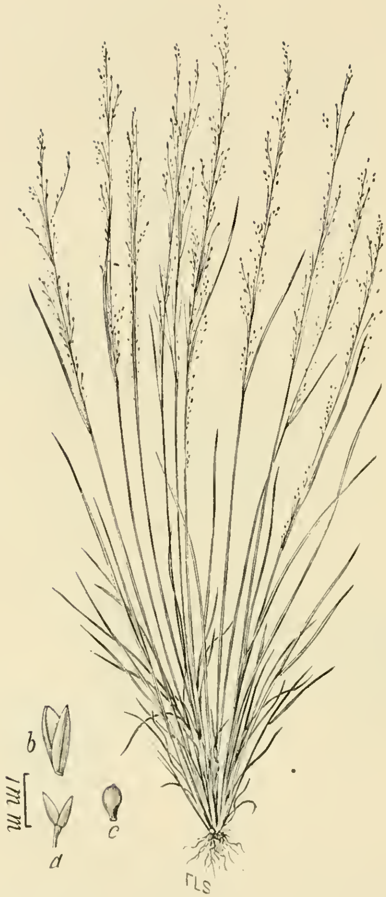

FIG. 454. **Sporobolus serotinus** (Torr.) A. Gray, Man. 577. 1848. (*Agrostis serotina* Torr. 1824.) LATE DROP-SEED.—A slender, erect perennial 1.5 to 4.5 dm. high, with very narrow, flat leaves and delicate, open panicles 6 to 18 cm. long. Spikelets about 1.5 mm. long, with the outer glumes (*a*), about one-half the length of the flowering glume.—Bogs and wet, sandy soil, Maine to New Jersey and westward to Michigan. August, September.

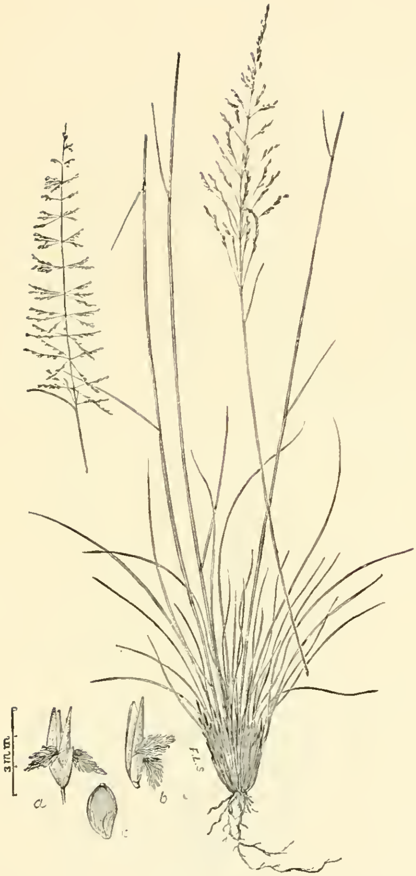

FIG. 455. **Sporobolus junceus** (Michx.) Kunth, Revis. Gram. **1**: 68. 1835. (*Agrostis junceus* Michx. Flor. Bor. Am. 1: 52. 1803.) RUSH GRASS.—A glabrous, erect, slender, wiry perennial with setaceous leaves, the basal ones 12 to 24 cm. long, and open panicles 6 to 14 cm. in length. Spikelets (*a*) 2.5 to 3 mm. long, with very unequal empty glumes, the first one-fourth to one-third as long as the second, which equals the subacute flowering glume.—Dry, sandy soil, Virginia to Florida and westward to Texas. February–December.

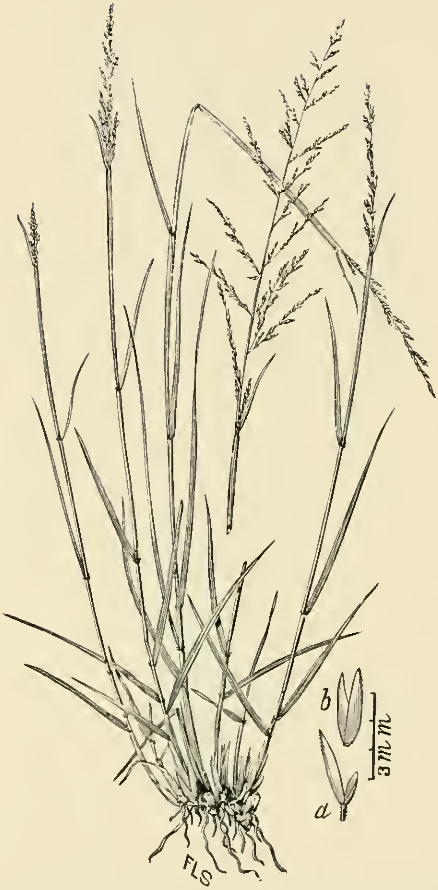

FIG. 456. **Sporobolus cryptandrus** (Torr.) A. Gray, Man. 576. 1848. (*Agrostis cryptandra* Torr.) SAND RUSH-GRASS.—An erect, glabrous, caespitose perennial, 4 to 7 dm. high, with flat leaves 6 to 12 cm. long, and open panicles 12 to 20 cm. long. Spikelets 2 to 3 mm. long.—Sandy soil, Massachusetts and Pennsylvania, westward to Montana and Washington, southward to Texas and New Mexico. [Mexico.] June-September.

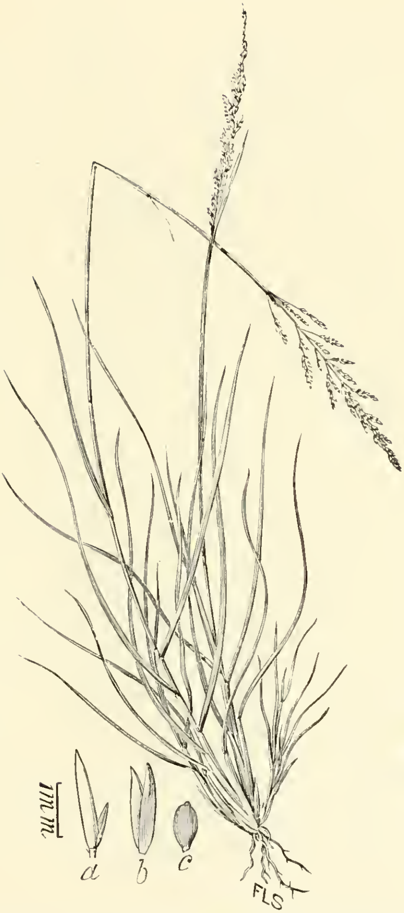

Fig. 457. **Sporobolus domingensis** (Trin.) Kunth, Enum. Pl. **1**: 214. 1833. (*Vilfa domingensis* Trin.; *Agrostis domingensis* Schultes.) West Indian Rush-grass.—An erect, glabrous, branching perennial, usually about 3 dm. high, with rather rigid, flat, attenuate-pointed leaves and narrow, many-flowered panicles 5 to 6 cm. long. Spikelets nearly 2 mm. long.—Saline soil, near the coast, Florida. [West Indies.] June–September.

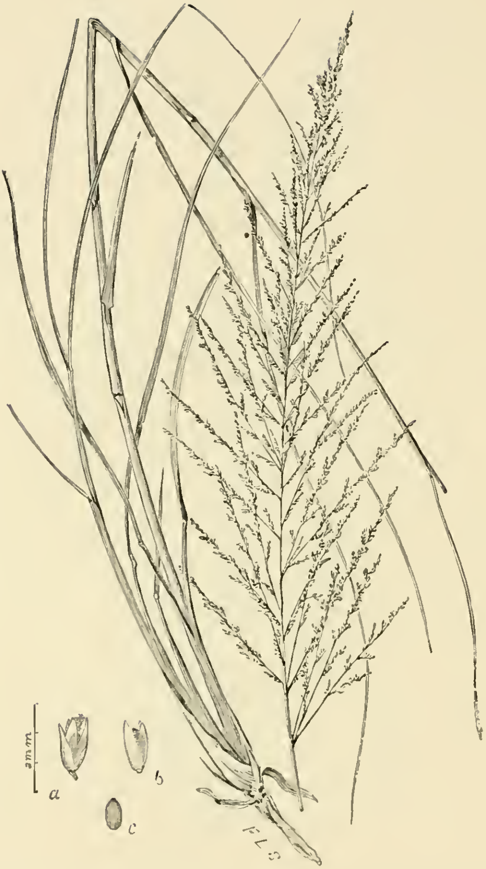

FIG. 458. **Sporobolus wrightii** Scribn. Bull. Torr. Bot. Club, 9: 103. 1882. SACCATON.—A stout, erect perennial, 10 to 18 dm. high, with long leaves and many-flowered, open panicles 30 to 60 cm. long. Spikelets (*a*) 2 mm. long, with thin, unequal, empty glumes, the second nearly as long as the flowering glume, which is of similar texture to the empty ones.—"Adobe" soil, Texas, New Mexico, and Arizona. July–September.

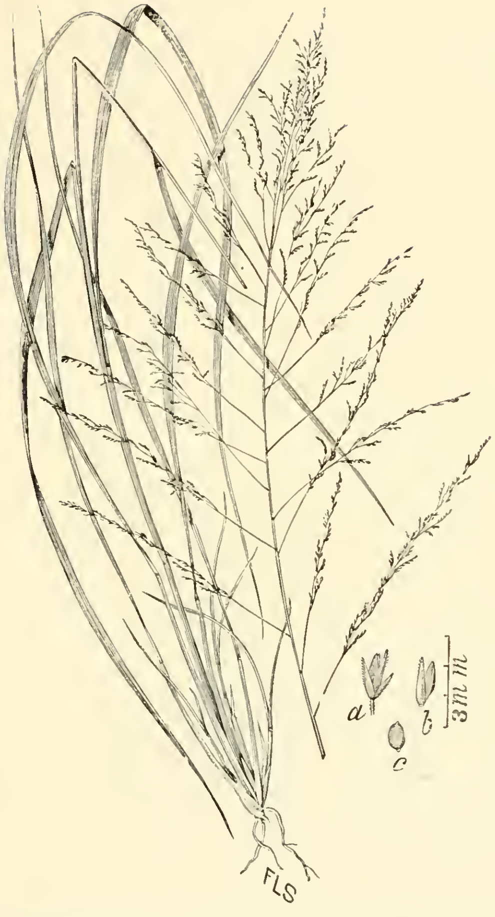

FIG. 459. **Sporobolus buckleyi** Vasey, Ill. N. Am. Grasses **1**^{2}: No. 17. 1891. BUCKLEY'S RUSH-GRASS.—A rather stout, erect perennial 6 to 9 d m. high, with long, flat leaves and erect, open panicles 20 to 35 cm. long. Spikelets (*a*) about 1.5 mm. long, with acute, unequal empty glumes, the second being nearly as long as the smooth, hyaline flowering glume.—Texas. [Mexico.] July.

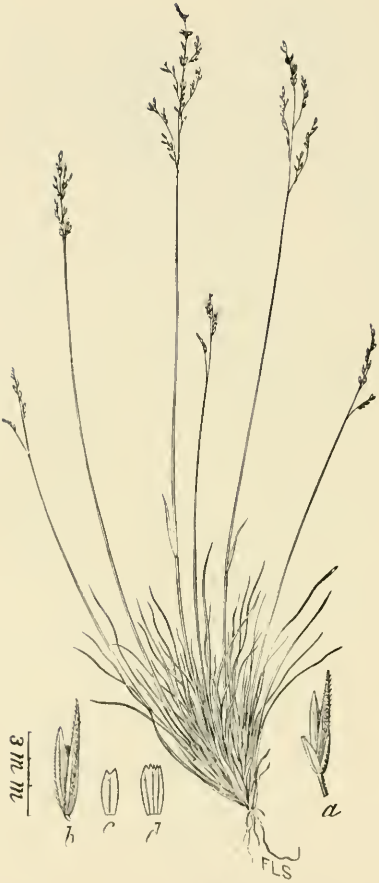

FIG. 460. **Sporobolus jonesii** Vasey, Coult. Bot. Gaz. **6** : 297. 1881. JONES' RUSH-GRASS.—A slender, wiry, densely tufted, erect perennial, 3 to 4.5 dm. high, with numerous short, rigid, involute radical leaves, and more or less spreading panicles 3 to 6 dm. long. Spikelets about 3 mm. long, with nearly truncate, or erose-dentate empty glumes (*a*, *c*, *d*) which are one-third to one-half as long as the acute flowering glume.—Soda Springs, near Summit, California. July.

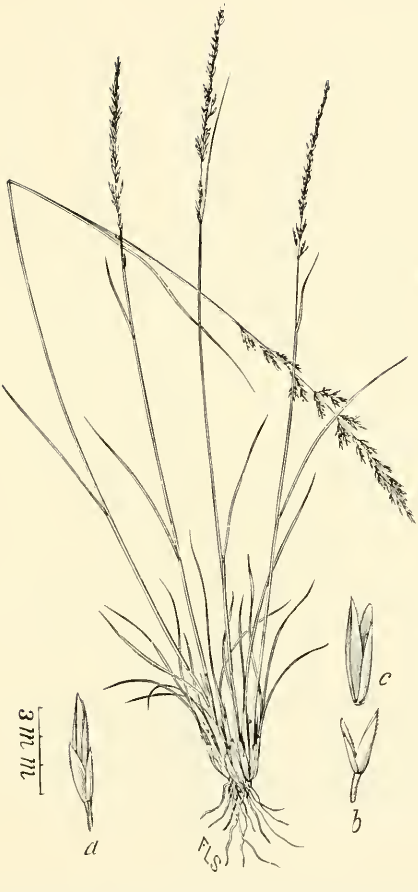

FIG. 461. **Sporobolus ligulatus** Vasey & Dewey, Contrib. U. S. Nat. Herb. **2**: 518. 1894.—A slender, smooth, upright perennial, 3 to 4.5 dm. high, with narrow, flat leaves, and contracted panicles 8 to 12 cm. long. Spikelets (*a*) 3 to 4 mm. long, subterete, with obtuse, nearly equal, empty glumes (*b*) which are about one-half as long as the smooth flowering glume.—Canyons, western Texas. September.

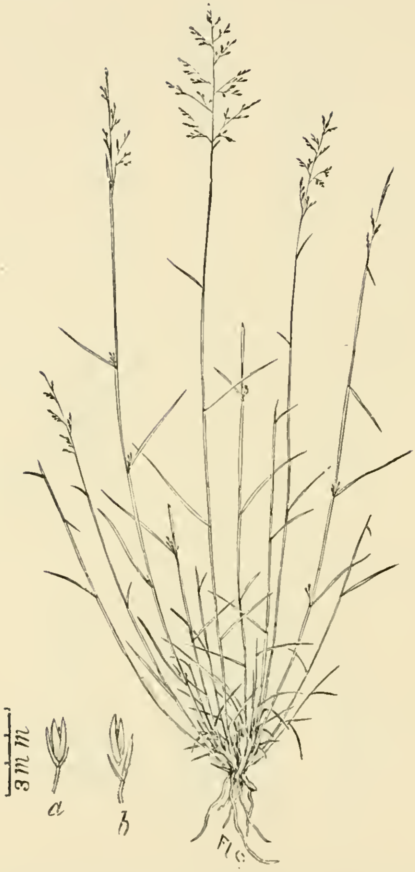

FIG. 462. **Sporobolus nealleyi** Vasey, Bull. Torr. Bot. Club, **15**: 49. 1888. NEALLEY'S RUSH-GRASS.—A pale green, slender, densely tufted, erect, perennial 1.5 to 5 dm. high, with more or less villous sheaths, rigid, flat, spreading leaves 4 to 10 cm. long, and open panicles 3 to 8 cm. long. Spikelets (*a*, *b*) about 2 mm. long, with narrow, unequal, empty glumes.—Western Texas and New Mexico. July.

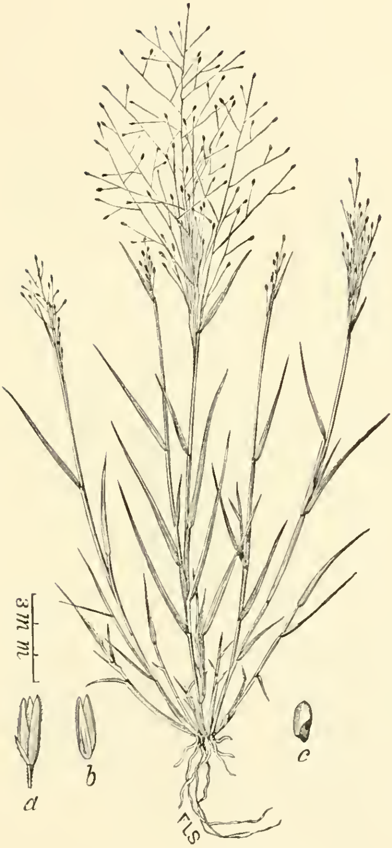

FIG. 463. **Sporobolus texanus** Vasey, Contrib. Nat. Herb. **1**: 57. 1890. TEXAN DROP-SEED.—A rather slender, rigid perennial about 3 dm. high, with stiff, flat leaves 4 to 6 cm. long, and open, capillary panicles 10 to 16 cm. long. Spikelets (*a*) about 2 mm. long on capillary pedicels, with unequal empty glumes, the first about one-half as long as the spikelet.—Salt marshes, etc., Kansas to Texas. July, August. Closely allied to *Sporobolus asperifolius.*

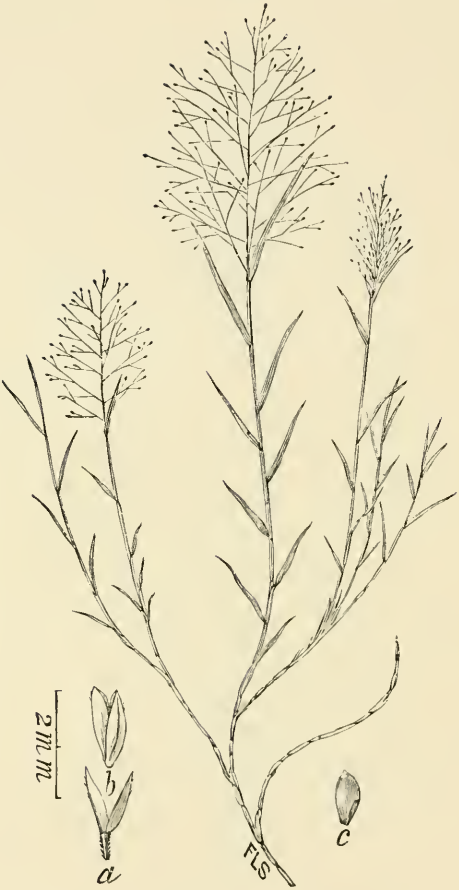

Fig. 464. **Sporobolus asperifolius** (Nees & Mey.) Thurb. in Brewer & S. Wats. Bot. Calif. **2**:269. 1880. (*Vilfa asperifolia* Nees & Meyer). Rough-leafed Salt-grass.—A slender, much-branched, leafy perennial 1 to 3.5 dm. high, with diffuse panicles 6 to 10 cm. long. Spikelets 1 to 5 mm. long with nearly equal, acute empty glumes (*a*).—Alkaline soil, Assiniboia to the Dakotas and Missouri westward to British Columbia and California. June–September.

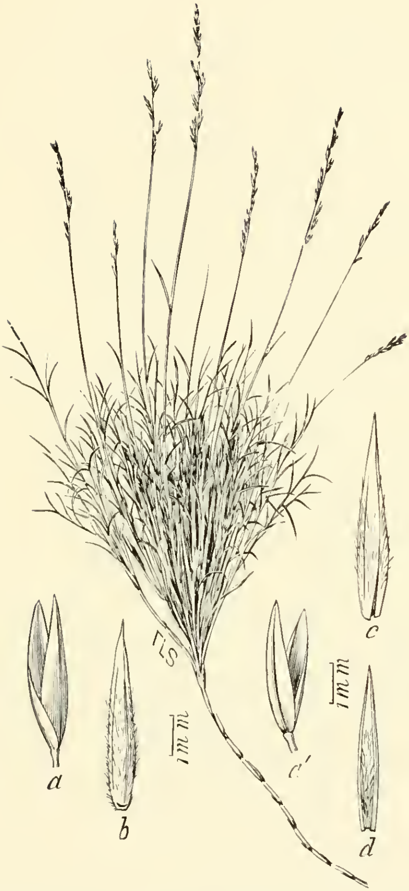

FIG. 465. **Sporobolus thurberi** Scribn. U. S. Dept. Agr. Div. Agros. Bull **11**: 48. fig. 5. 1898. THURBER'S RUSH-GRASS.—A slender, very much branched and leafy perennial 1.5 to 2.5 dm. high, from creeping rootstocks, with contracted, linear, long-exserted panicles 3 to 5 cm. long. Spikelets straw-colored, 4 to 5 mm. long. Flowering glume (*b*, *c*). are pilose for half their length.—New Mexico(?)

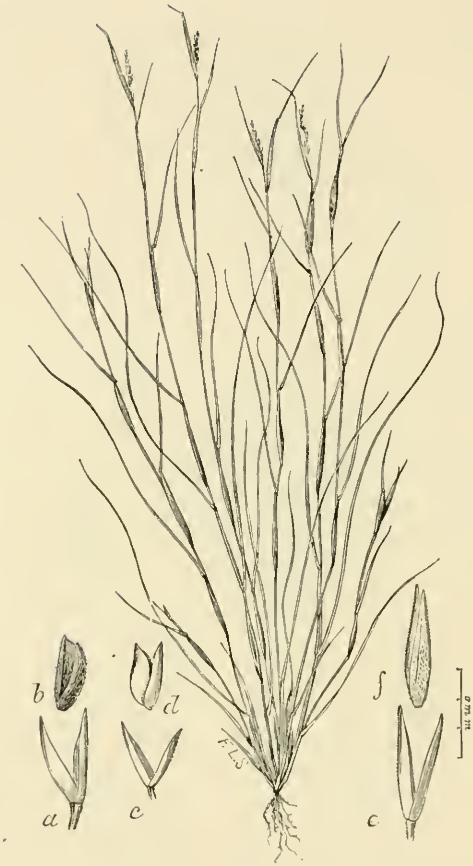

Fig. 466. **Sporobolus vaginæflorus** (Torr.) Wood, Classbook of Bot. 775. 1861. (*Vilfa vaginæflora*, Torr. 1834.) Southern Poverty-grass.—A slender, cæspitose annual, 1.5 to 4 dm. high, with very narrow, short leaves and simple, few-flowered, terminal and axillary, spike-like panicles which are about 2 cm. long and mostly inclosed in the somewhat inflated leaf-sheaths. Spikelets 2 to 4 mm. long.—Dry fields and waste places, Vermont to South Dakota and Wyoming, southward to Georgia and Texas. August, September.

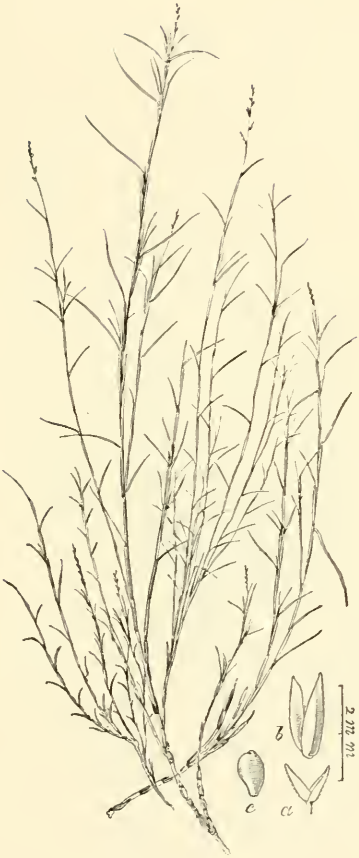

FIG. 467. **Sporobolus utilis** Torr. Pac. R. Ry. Rept. **5** : 365. 1853. APAREJO GRASS.—A slender, wiry, much branched perennial, with short, spreading, or recurved, involute leaves and narrow, simple, few-flowered panicles. Spikelets about 2.5 mm. long, with the empty glumes (*a*), about one-half the length of the obtuse flowering glume.—Swampy places, along mountain streams, western Texas to Nevada and southern California. [Mexico.] January–December.

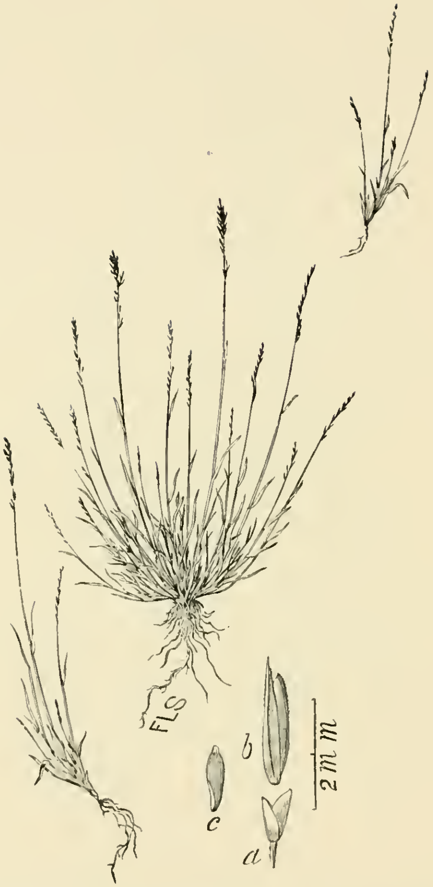

FIG. 468. **Sporobolus simplex** Scribn. U. S. Dept. Agr. Div. Agros. Bull. **11**: 48, fig. 6. July, 1898. MOUNTAIN DROP-SEED.—A low, densely cæspitose, leafy annual 0.5 to 1.5 dm. high, with smooth culms, short, flat leaves, and linear panicles 2 to 4 cm. long. Spikelets 2 to 2.3 mm. long, with broadly obtuse or truncate empty glumes (*a*), which are hardly one-half as long as the mucronate-pointed flowering glumes.—Moist places in the mountains of Colorado and Idaho. July–September.

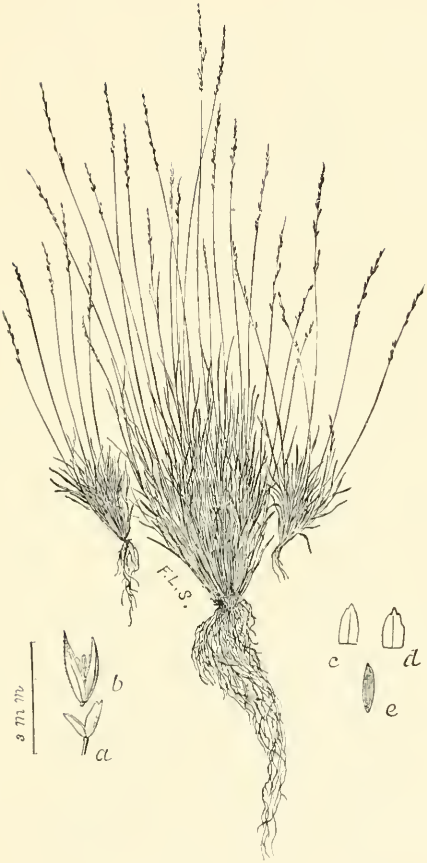

FIG. 469. **Sporobolus filiformis** (Thurb.) Scribn. New Comb. (*Vilfa depauperata filiformis* Thurb. in S. Wats. Bot. King Exped 376. 1871.) Slender Rush-grass.—A very slender, densely tufted annual 0.8 to 3 (usually about 1.5) dm. high, with short, narrow leaves, scape-like culms, and linear, few-flowered panicles. Spikelets about 2 mm. long.—Moist soil in the mountains, Washington to California and eastward to Utah and (?) Colorado. July–September.

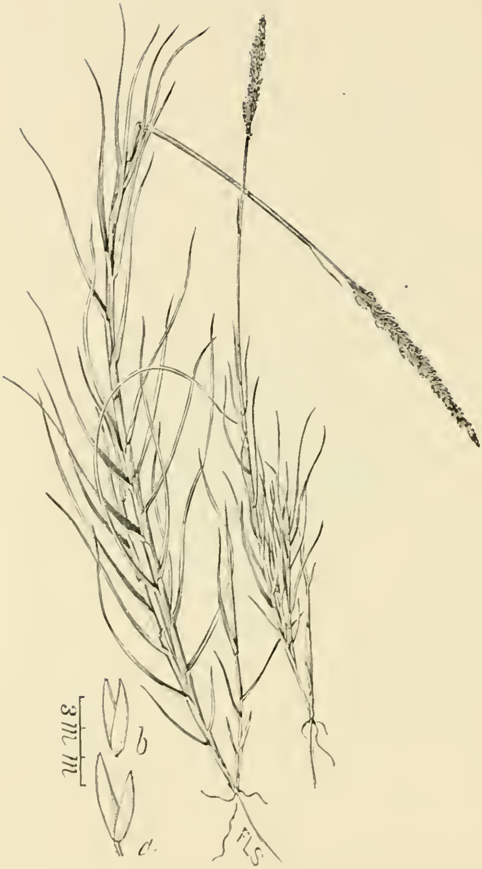

FIG. 470. **Sporobolus virginicus** Kunth, Revis. Gram. **1**: 67. 1835. (*Agrostis virginica* Linn.) SEASIDE RUSH-GRASS.—A decumbent, or erect and more or less branching, leafy perennial 1.5 to 6 dm. high, with long, creeping rootstocks and densely flowered, spike-like panicles 3 to 6 cm. long. Spikelets 2 to 3 mm. long.—Sandy shores Virginia to Florida, westward to Texas. [Mexico and West Indies.] August–September.

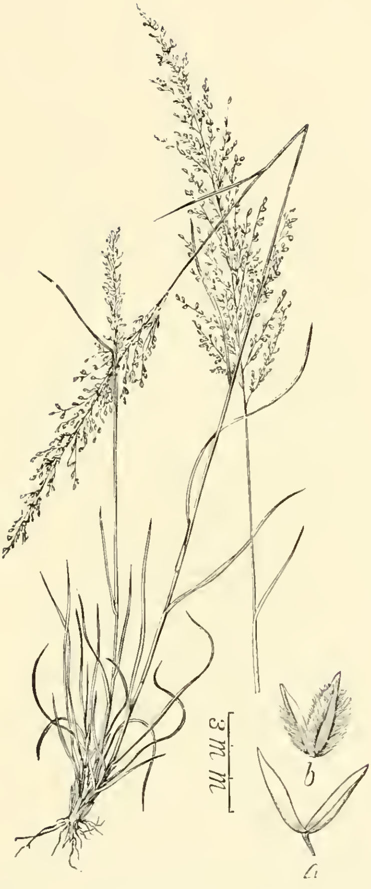

FIG. 471. **Blepharoneuron tricholepis** (Torr.) Nash, Bull. Torr. Bot. Club, **25**: 88. (?) (*Vilfa tricholepis* Torr. Pacif. R. Ry. Rept. **4**: 155. 1857).—A slender, erect, densely cæspitose perennial 2.5 to 6 dm. high, with narrow, glabrous leaves and more or less spreading panicles 6 to 18 cm. long. Spikelets 2.5 to 3 mm. long, with the nerves of the flowering glume (*b*) densely clothed with long hairs.—Dry soil, Utah, Colorado to Texas, and westward to Arizona. [Mexico.] July–September.

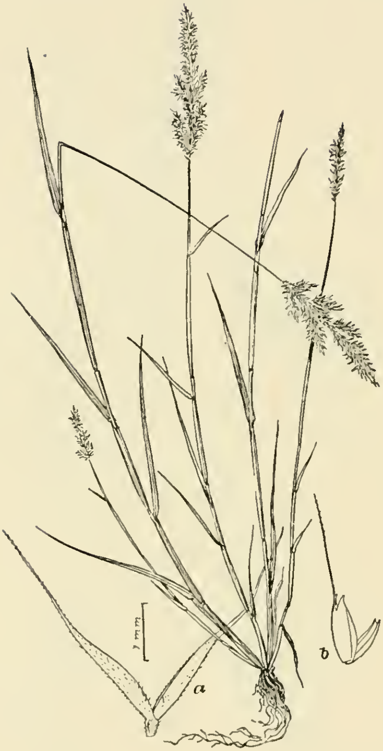

Fig. 472. **Polypogon littoralis** (With.) Smith Comp. Fl. Brit. Ed. 2, 13. 1816 (*Agrostis littoralis* With. Bot. Arr. Brit. Pl. Ed. 3, 2 : t. 23. 1796). Beard Grass.—A tufted, slender, or rather stout perennial, 3 to 6 dm. high, with scabrous, flat leaves and narrow, densely flowered, much lobed panicles, 5 to 12 cm. long. Spikelets, 2 to 3 mm. long, with scabrous, subulate-pointed empty glumes (*a*) and broadly truncate or emarginate, awned flowering glumes, 1 mm. long. Awn about 2 mm. long.—Wet places California and Oregon to Vancouver Island. [Europe and South America.] May, June.

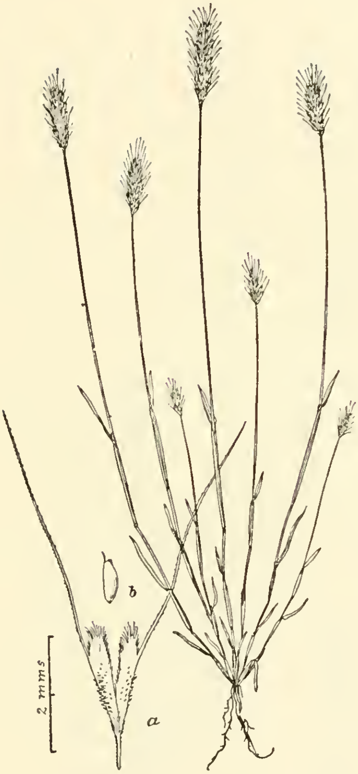

FIG. 473. **Polypogon maritimus** Willd. in Nov. Act. Soc. Nat. Cur. Berol. **3**: 443. 1801. (*Phleum crinitum* Roxb.) SEA-SIDE BEARD-GRASS.—An erect, slender annual 1.5 to 3 dm. high, with flat leaves and densely-flowered, spike-like panicles 2 to 4 cm. long. Spikelets with two-lobed, awned empty glumes (*a*), which are villous at the apex and twice longer than the short-awned floral glume (*b*). Awn of the empty glumes 4 to 6 mm. long.—Lower California and, according to Chapman, along the seashore of North and South Carolina. [Europe.] June.

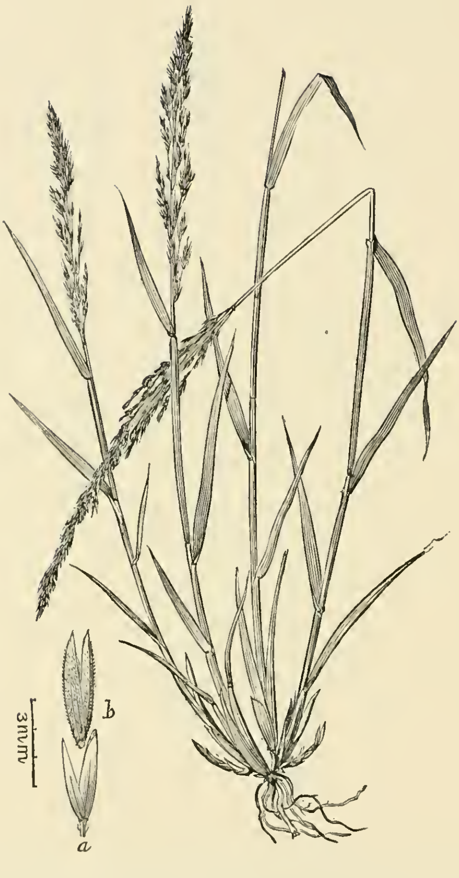

FIG. 474. **Arctagrostis latifolia** (R. Br.) Griseb. in Ledb. Flor. Ross. **4** : 434. 1853. (*Colpodium latifolium* R. Br. Suppl. App. Parry's Voy. 286. 1824). BROAD-LEAFED ARCTIC BENT.—A rather stout, glabrous, erect perennial 1.5 to 6 dm. high, with narrow panicles 3 to 16 cm. long. Spikelets 3 to 4 mm. long, with nearly equal empty glumes (*a*) shorter than the obtuse, scabrous flowering glume and palea (*b*).—Greenland and Labrador to Alaska. [Northern Europe and Asia.] August.

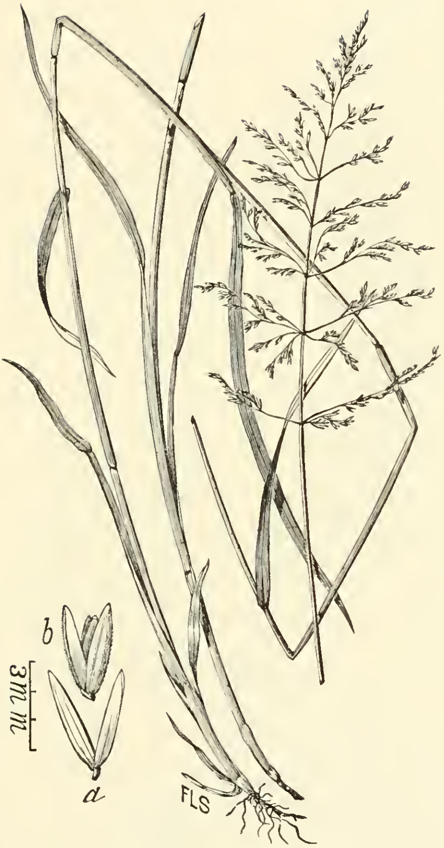

Fig. 475. **Arctagrostis arundinacea** (Trin.) Beal, Grasses N. Am., **2**: 317. 1896. (*Vilfa arundinacea* Trin. Unifl., 157. 1824; Icon. t., 55. *Sporobolus arundinaceus* Vasey. *Colpodium arundinaceum* Hook.). Reed Bent.—A stout perennial 6 to 12 dm. high, with flat leaves and open panicles 20 to 35 cm. long. Spikelets compressed, with nearly equal glumes (*a*) about 4.5 mm. long.—Alaska and British America. [Northeastern Asia]. July, August.

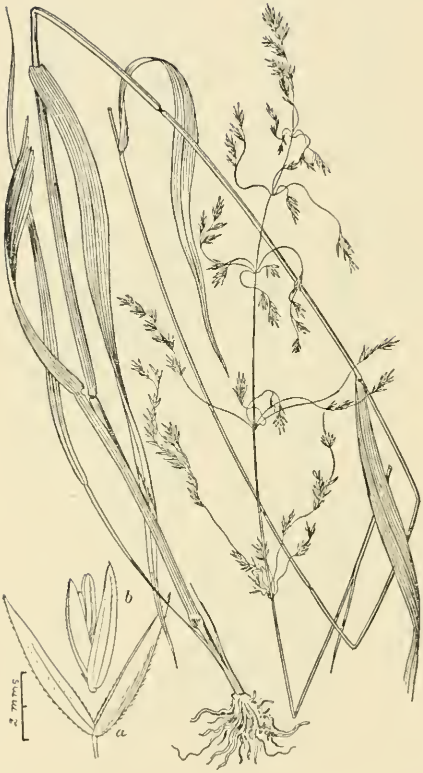

Fig. 476. **Cinna bolanderi** Scribn. Proc. Acad. Nat. Sci. Phila. 1884. 290. Californian Reed-grass.—A stout, leafy, erect perennial 15 to 22 dm. high, with loose, open panicles 25 to 36 cm. long. Spikelets about 5 mm. long, with broadly lanceolate, nearly equal empty glumes (*a*), which are a little longer than the nearly sessile floret (*b*).—California, No. 6090, Bolander. August.

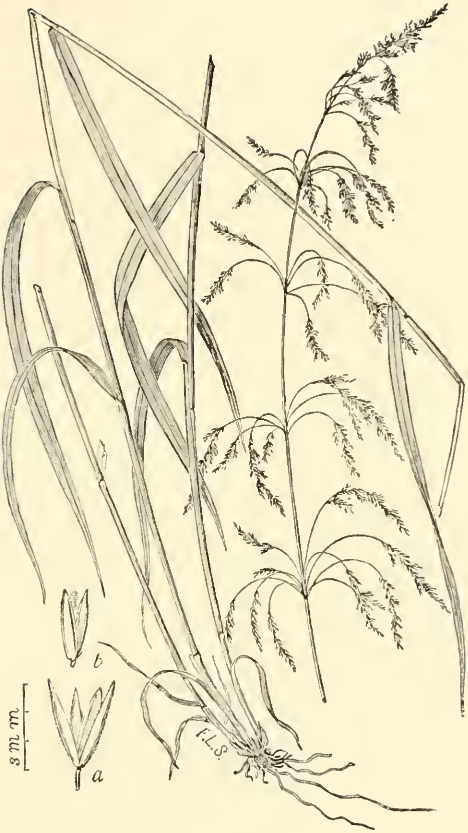

Fig. 477. **Cinna latifolia** (Trev.) Griseb. in Ledb. Fl. Ross. **4**: 435. 1853. (*Agrostis latifolia* Treviran, 1830; *Cinna pendula* Trin. 1841.) Slender Indian Reed.—A rather slender, smooth perennial, with erect, simple culms, long, flat leaves 4 to 12 mm. wide, and open, nodding panicles 10 to 20 cm. long. Spikelets (*a*) about 3 mm. long, with nearly equal, acute outer glumes and short-awned or nearly awnless flowering glume (*b*), which is raised on a short stipe.—Thickets and moist woodlands, Newfoundland to British Columbia and southward to North Carolina and **Utah.** July–September.

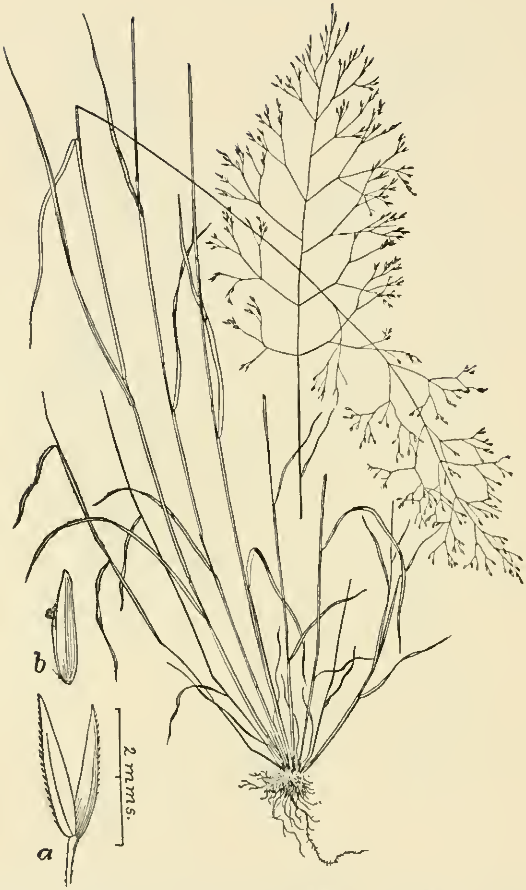

Fig. 478. **Agrostis perennans** (Walt.) Tuckerm. Am. Journ. Sci. **45** : 41. 1813. (*Cornucopiæ perennans* Walt. 1788.) Perennial Bent or Thin Grass.—A slender, sparingly branched, leafy perennial, with weak, ascending culms 3 to 7.5 dm. long, and diffuse, capillary panicles 8 to 16 cm. long. Spikelets 1.5 to 2 mm. long, with acute empty glumes (*a*), which are a little longer than the glabrous flowering glume (*b*).—Damp, shaded places, Maine to Minnesota and Nebraska, southward to South Carolina and Mississippi. May–September.

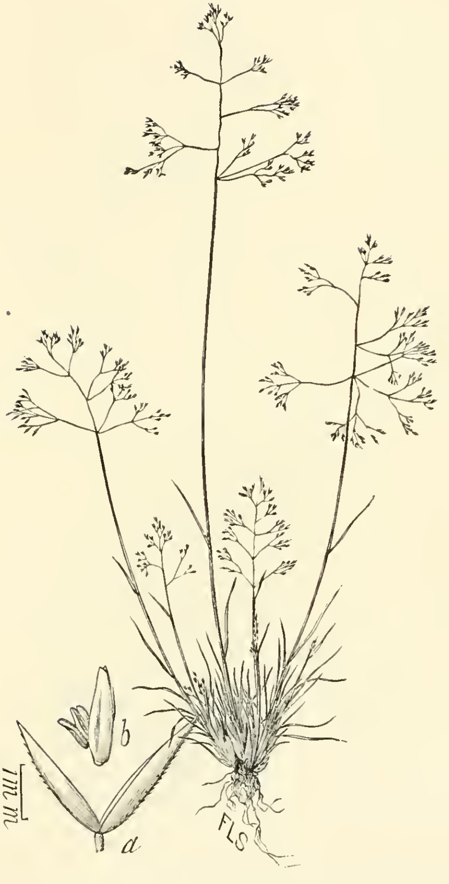

FIG. 479. **Agrostis geminata** Trin. Unifl. 207. 1824. MOUNTAIN BENT.—A slender, erect, densely cæspitose perennial 2 to 3.5 dm. high, with short, flat leaves, chiefly basal, and capillary, spreading panicles 5 to 8 cm. long. Spikelets 2.5 to 3 mm. long, truncate or retuse flowering glumes (*b*) about 1.7 mm. long. —British Columbia to Alaska. August.

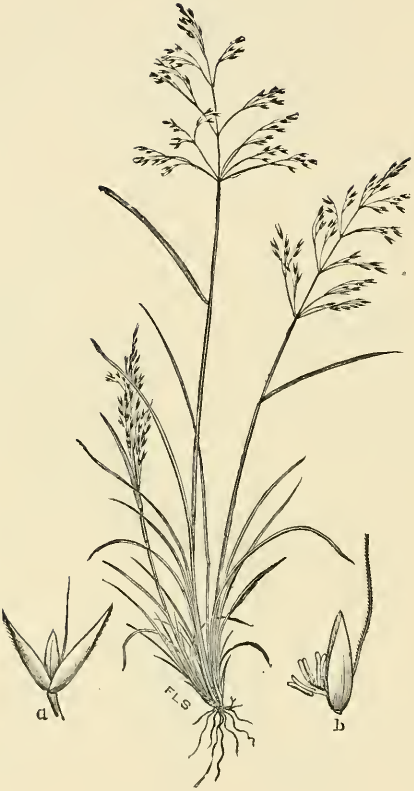

FIG. 480. **Agrostis rubra** Linn. Sp. Pl. 62. (*A. rupestris* Chapm. not All). RED BENT.—A tufted, alpine perennial 1.5 to 4 dm. high, with narrow, flat leaves, open, capillary panicles 5 to 10 cm. long, and awned spikelets (*a*) 2.5 to 3 mm. long.—High mountains, Vermont and New Hampshire to North Carolina and Colorado; also in Labrador and Newfoundland. [Europe.] July–August.

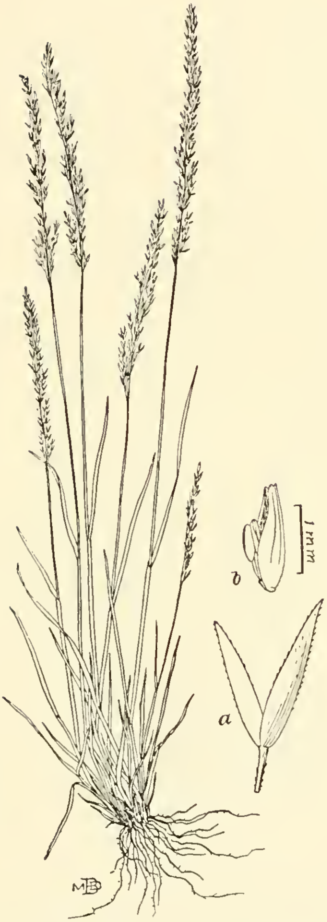

FIG. 481. **Agrostis varians** Trin. Agrost., **1**^{2} : 68. 1841. SLENDER BENT-GRASS.—A densely cæspitose perennial 1 to 2.5 dm. high, with flat, erect leaves and contracted, almost spike-like panicles 3 to 5 cm. long. Spikelets 2.3 mm. long, with nearly equal, subacute empty glumes (*a*) and minutely toothed, hyaline, awnless flowering glumes (*b*) 1.7 mm. long.—Mountains of Oregon, Washington, and California July–September.

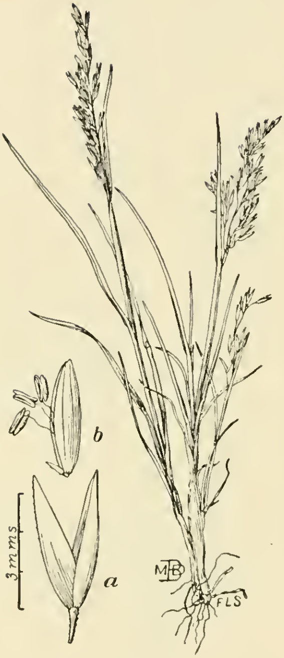

Fig. 482. **Agrostis paludosa** Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 49. fig. 7, 1898. Marsh Bent.—A low, densely cæspitose perennial 1 to 1.5 cm. high, with soft, narrow leaves, and narrow, rather densely flowered panicles 3 to 5 cm. long. Spikelets about 3 mm. long, with ovate-lanceolate, acute empty glumes (*a*), which are a little longer than the broadly obtuse and minutely scabrous flowering glume (*b*). Palea 0.5 mm. long.—Labrador. August, September.

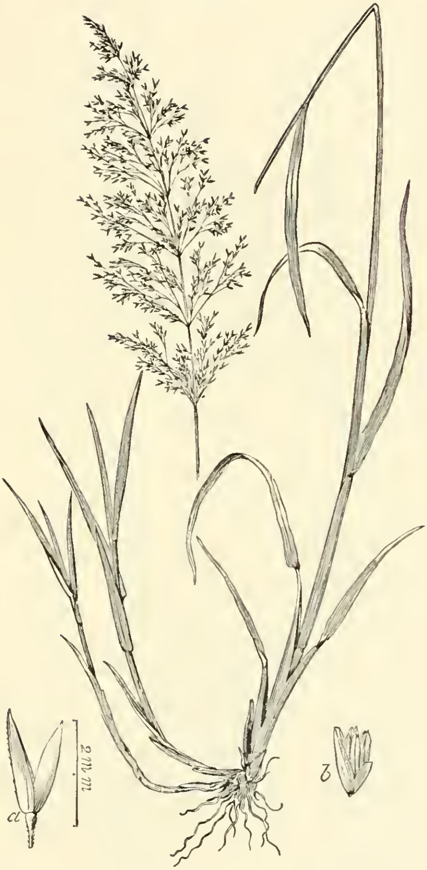

Fig. 483. **Agrostis alba** Linn. Sp. Pl. 63. Herd's Grass or Red-top.—A well known perennial of variable habit, often stoloniferous, with smooth culms 3 to 9 dm. high, flat leaves, and erect, many-flowered, open panicles 4 to 18 cm. long. Spikelets 2 to 3 mm. long, with abruptly acute empty glumes (*a*), which are a little longer than the obtuse or truncate flowering glume. Palea one-half to three-fourths as long as the glume.—Throughout the United States, excepting in the extreme South. [Europe.] June–September.

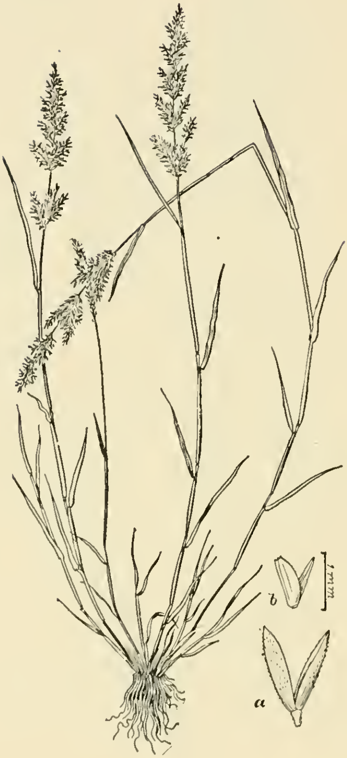

Fig. 481. **Agrostis verticillata** Vill. Prosp. 16. 1779; Trin. Icon. Gram. t. 36 (*A. stolonifera L.?*) Water Bent-grass.—A slender perennial, with flat leaves, erect or decumbent culms, 2 to 6 dm. long, and densely flowered, more or less interrupted panicles 5 to 25 cm. long. Spikelets about 1.5 mm. long with nearly equal, minutely pubescent, empty glumes (*a*) about one-half longer than the obtuse and minutely dentate, awnless flowering glume.—Moist places, Utah to Texas, and westward to California. [Mexico, South America, Europe, and India.] May–August.

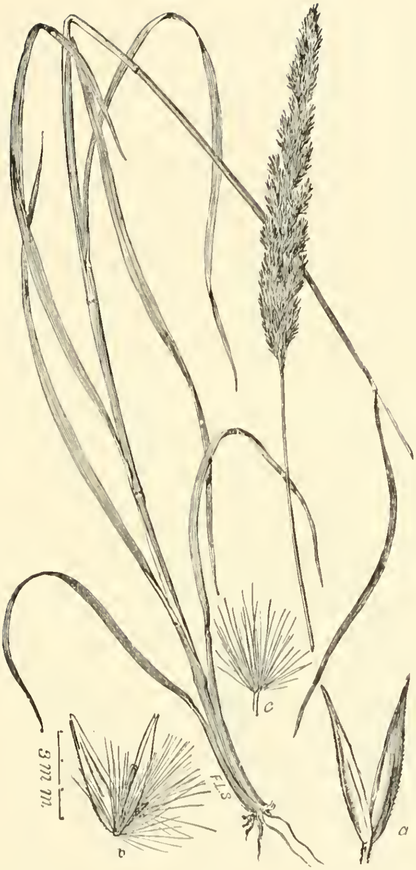

FIG. 185. **Calamagrostis cinnoides** (Muhl.) Scribn. Mem. Torr. Club. **5**: 42. 1895. (*Arundo cinnoides* Muhl.; *Calamagrostis nuttalliana* Steud.). NUTTALL'S REED-GRASS.—A stout, erect perennial, 9 to 15 dm. high, with rather broad, flat leaves and contracted panicles 6 to 14 dm. long. Spikelets 6 to 8 mm. long; prolongation of the rachilla (*c*), bearing at its apex a tuft of hairs.—Moist soil, Maine to North Carolina and Alabama, and west to Ohio. August, September.

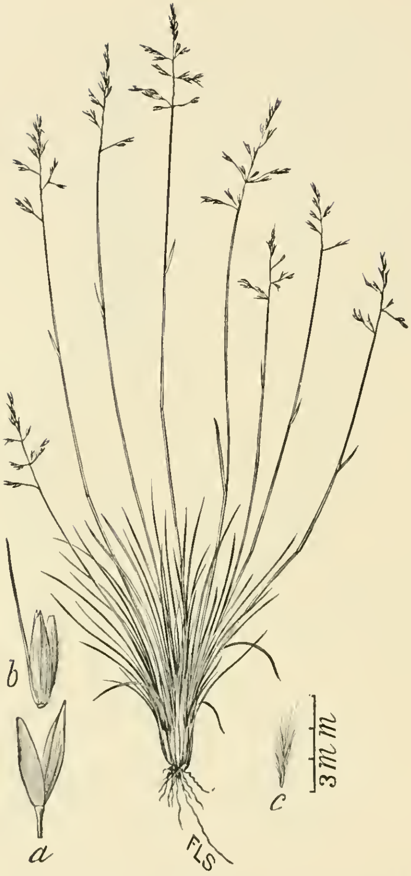

Fig. 486. **Calamagrostis breweri** Thurb. in Brewer & S. Wats. Bot. Calif. **2**: 280. 1880. Brewer's Reed-grass.—A slender, densely tufted perennial, 1.5 to 4 dm. high, with numerous, setaceously involute, basal leaves, short culm leaves and open, few-flowered panicles 2 to 6 cm. long. Spikelets with nearly equal glumes which are 3 to 4 mm. long, the 4-toothed flowering glume with a small tuft of very short hairs on each side at the base and an exserted straight awn.—Mountains of California. July, August.

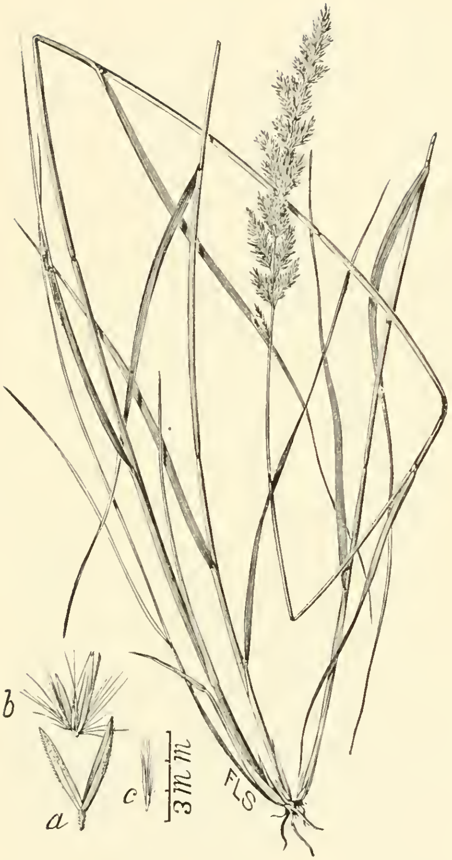

FIG. 487. **Calamagrostis inexpansa** A. Gray in Torr. Fl. N. Y. **2**: 445, t. 152. 1843. (*Calamagrostis confinis* A. Gray, Man. Ed. 2, 547, not Nutt.?) BOG REED-GRASS.—A slender, erect perennial 3 to 6 dm. high with narrow, flat leaves and contracted panicles 5 to 18 cm. long. Spikelets 3 to 4 mm. long with nearly equal, acute empty glumes (*a*) about the length of the flowering glume, the basal hairs of which nearly equal it in length or are one-third shorter.—Damp, sandy soil, New York and New Jersey westward to South Dakota and Colorado. July–September.

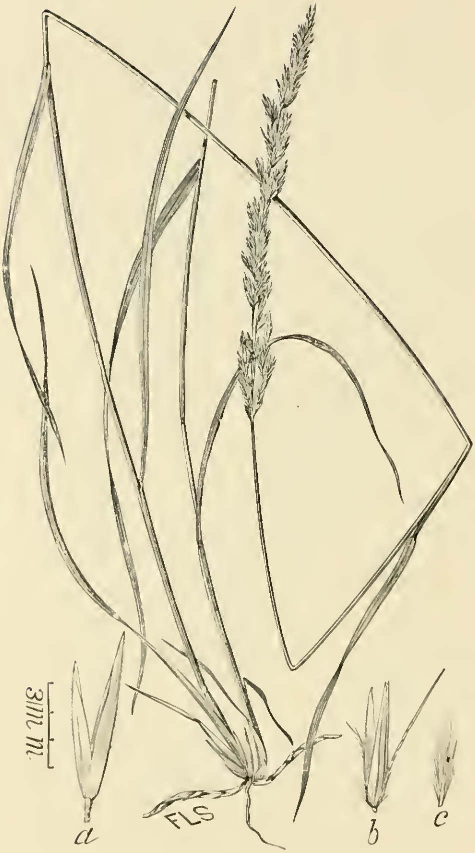

Fig. 488. **Calamagrostis porteri** A. Gray, Proc. Am. Acad. 6: 79. 1862. Porter's Reed Bent.—A slender, erect, glabrous perennial 6 to 12 dm. high, with rough, flat leaves and narrow, rather loosely flowered panicles 8 to 16 cm. long. Spikelets 2 to 5 mm. long, with nearly equal glumes, the scabrous outer ones (*a*) very acute; the flowering glume obtuse, scabrous, with the basal hairs one-fourth to one-third its length.—Dry woodlands, New York and Pennsylvania. August.

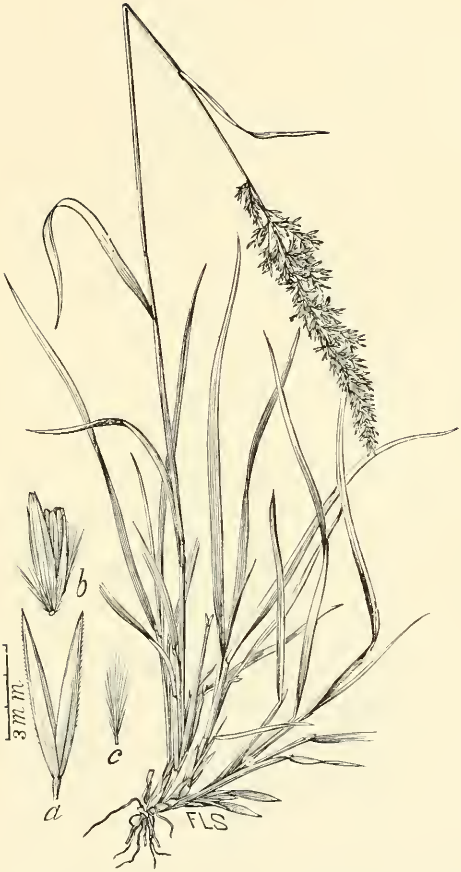

Fig. 489. **Calamagrostis scopulorum** M. E. Jones, Proc. Calif. Acad. Sci. (2), **5** : 722. 1895. Broom Reed-grass.—A slender, erect perennial 5 to 8 dm. high, with flat leaves and narrow, rather loosely flowered panicles 8 to 12 cm. long. Spikelets with narrowly lanceolate, acute, empty glumes (*a*) 5 mm. long, very short-awned or nearly awnless flowering glumes about 4 mm. long, and short callus hairs.—Wahsatch Mountains, Utah. September.

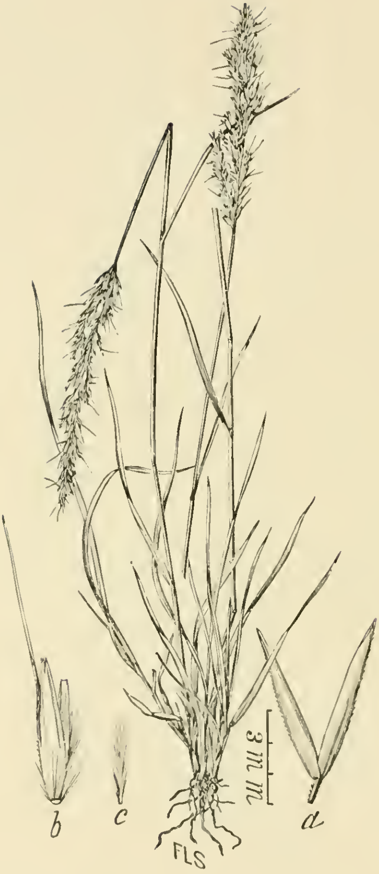

FIG. 490. **Calamagrostis vaseyi** Beal, Grasses N. Am. **2**: 314. 1896. VASEY'S REED-GRASS.—A densely cæspitose, erect perennial, 6 to 7.5 dm. high, with flat and rather rigid leaves and contracted, spike-like, often interrupted panicles 6 to 8 cm. long. Spikelets about 4.5 mm. long; flowering glume 3 mm. long with a nearly straight awn 3 to 4 mm. long.—Mountains of Washington and Oregon. July, August.

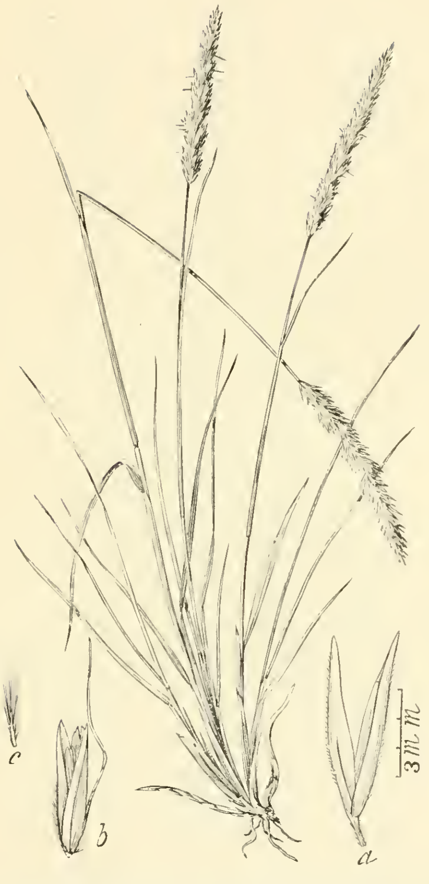

FIG. 491. **Calamagrostis purpurascens** R. Br. in Rich. App. Frankl. Journ. 731. 1823. PURPLE REED-BENT.—A rather rigid, densely cæspitose, erect perennial 3 to 6 dm. high, with firm, strongly involute leaves and densely flowered, spike-like panicles 6 to 8 cm. long. Spikelets 6 to 7 mm. long; flowering glumes (*b*) about 4.5 mm. long; awn much exceeding the glumes.—Dry, rocky soil in the mountains, Colorado to California and northward to Alaska. July, August.

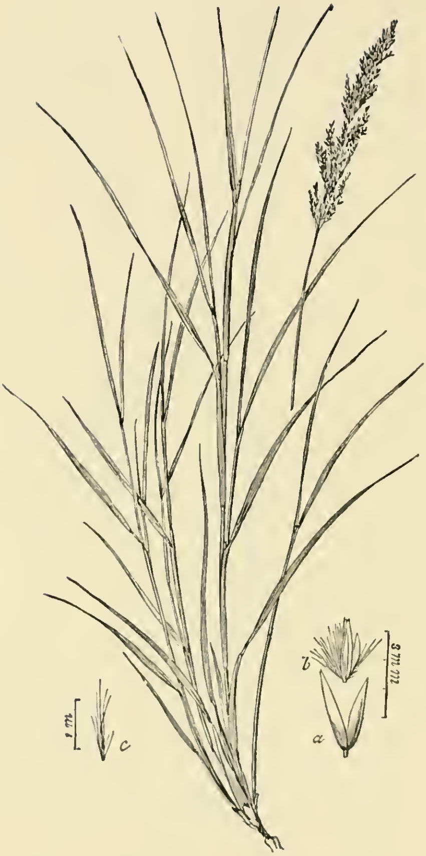

FIG. 492. **Calamagrostis macouniana** Vasey, Contr. Nat. Herb. **3**: 81. 1892. (*Deyeuxia macouniana* Vasey, Coult. Bot. Gaz. **10**: 297. 1885.) MACOUN'S REED-BENT.—A slender, erect, leafy perennial 3 to 6 dm. high, with narrow, flat leaves and narrow or (in anthesis) open, pyramidal panicles 6 to 8 cm. long. Spikelets with nearly equal empty glumes (*a*) about 3 mm. long, scarcely exceeding the short-awned flowering glume.—Moist sandy soil, Assiniboia to Missouri, Montana, and Washington. May–August.

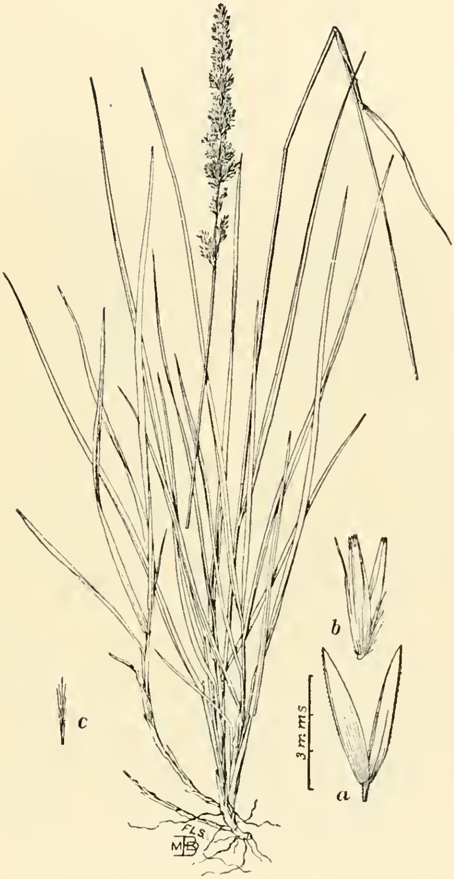

Fig. 493. **Calamagrostis fasciculata** Kearney, U. S. Dept. Agr., Div. Agros., Bull. **11** : 23, fig. 1. July, 1898. Couch Bentgrass.—A slender, rather rigid, erect perennial 6 to 10 dm. high, from creeping rootstocks, with narrow, mostly erect leaves and contracted panicles 5 to 10 cm. long. Spikelets about 4 mm. long, with a truncate and 4-dentate floral glume, which has a few short hairs at the base and bears an awn on the back below the middle, which usually exceeds the glume.—Mendocino and Marin counties, Cal. July, August.

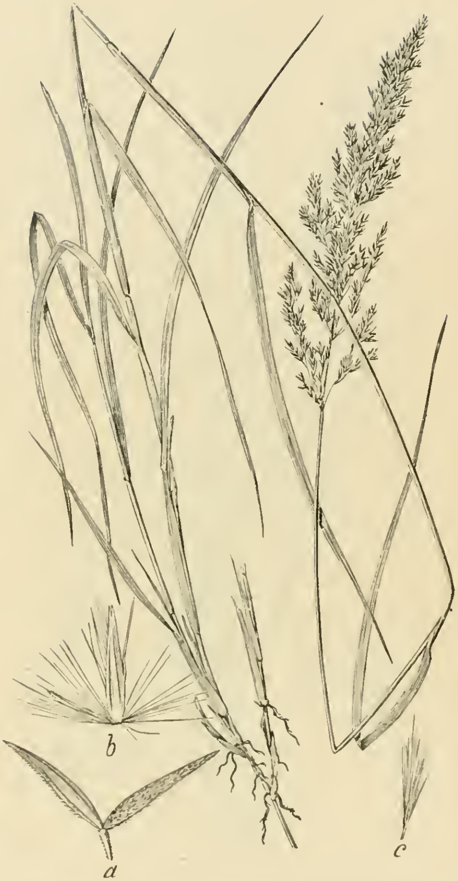

Fig. 494. **Calamagrostis langsdorffii** Trin. Gram. Unifl. 225. t. 4, f. 10. 1824. Langsdorf's Reed-bent.—A stout, erect perennial 6 to 12 dm. high, with long, flat leaves and open, pyramidal panicles 1 to 12 cm. long. Spikelets with long-acuminate, scabrous, empty glumes (*a*) 4 to 6 mm. long.—Moist meadows, etc., Newfoundland to Alaska and southward to the mountains of New England, Colorado, Utah, and northern California. June–September.

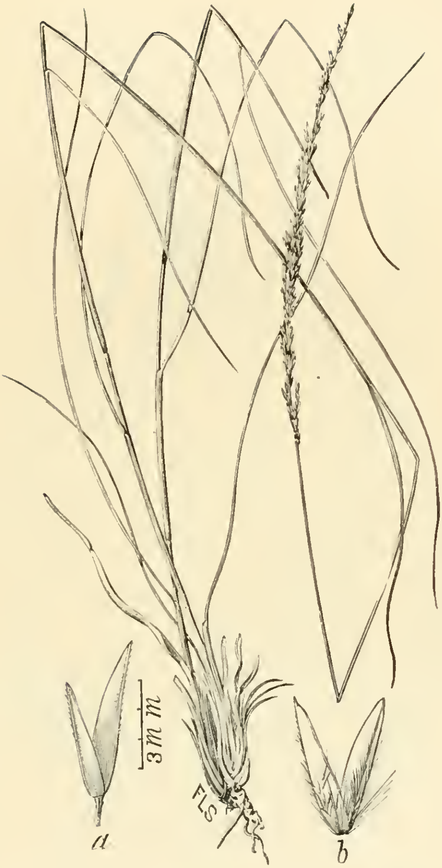

FIG. 495. **Calamovilfa curtissii** (Vasey) Scribn. n. comb. (*Calamagrostis curtissii* Vasey, Contrib. Nat. Herb. **3**: 85. 1892; *Ammophila curtissii* Vasey, Bull. Torr. Bot. Club, **11**: 7. 1884.) SOUTHERN REED-GRASS.—A rather slender, wiry, erect perennial 9 to 18 dm. high, from a stout rhizome, with narrow, involute leaves and a contracted panicle 16 to 20 cm. long. Spikelets about 5 mm. long, with unequal empty glumes (*a*) and more or less hairy flowering glume and palea (*b*) bearing a few short hairs on the callus.—Low pine barrens, Florida. July, August.

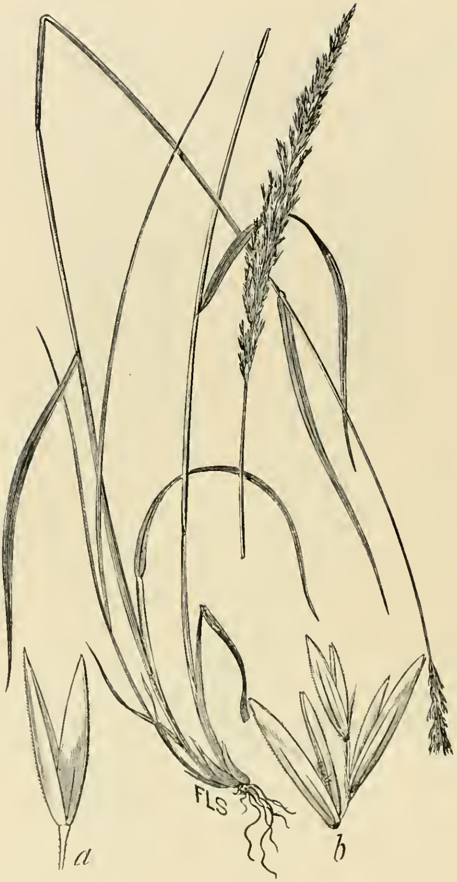

Fig. 496. **Trisetum muticum** (Boland.) Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 50, fig. 10. July, 1898. (*Trisetum subspicatum* var. *muticum* Bol.; *Trisetum wolfii* Vasey, in part.) Beardless False Oat.—A rather stout or more often slender, erect, cæspitose perennial, 3 to 7.5 dm. high with flat, glabrous, sometimes pilose leaves, narrow or densely flowered panicles 8 to 18 cm. long.—Dry situations, Montana to British America and southward to California, Wyoming, and Colorado. July–September.

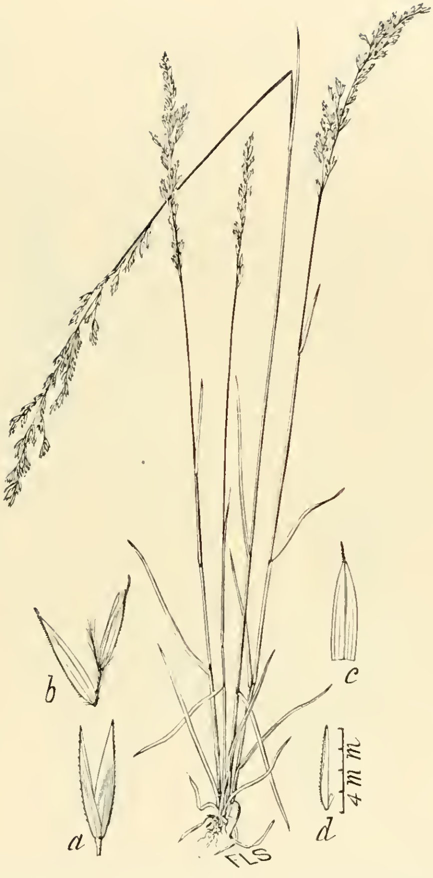

FIG. 497. **Trisetum wolfii** Vasey, in Bot. Wheeler Exped. 6: 294, t. 27. 1878. WOLF'S FALSE OAT.—A slender, erect, tufted perennial, with rather short, flat, scabrous leaves and loosely-flowered, nodding and contracted panicles 5 to 10 cm. long. Spikelets 2-flowered, 5 to 6 mm. long, with lanceolate, very acute, nearly equal empty glumes (*a*) and acute, punctate-scabrous, short-awned flowering glumes (*c*).—Mountains of Colorado. August.

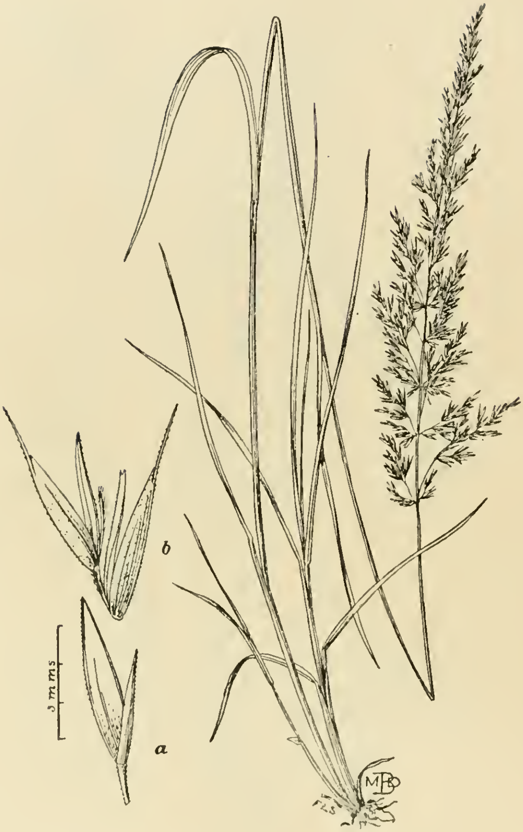

FIG. 498. **Trisetum argenteum** Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 19, fig. 8. July, 1898. SILVER OAT-GRASS.—A slender, erect perennial, with smooth culms 5 to 7 dm. high, minutely scabrous sheaths and leaves and narrow, silvery gray or purplish panicles 10 to 20 cm. long. Spikelets 4 to 5 mm. long, 1- to 2-flowered, with unequal, acute, empty glumes and minutely scabrous, short-awned flowering glumes, the first one of which is about 4 mm. long.—Near Silverton and Twin Lakes, Colorado. August.

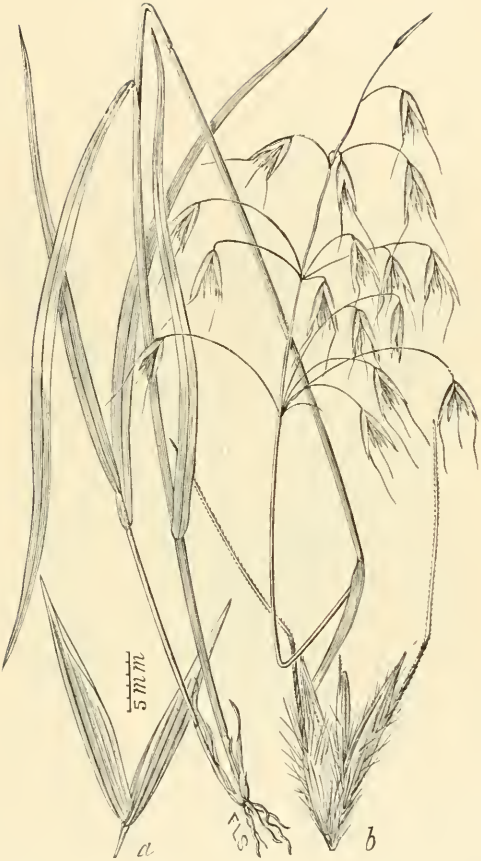

FIG. 499. **Avena fatua** Linn. Sp. Pl. 80. WILD OAT.—An erect, glabrous annual 6 to 12 dm. high, with flat leaves and spreading panicles of large oat-like, nodding spikelets. Spikelets 2-to 4-flowered, with long (1.5 to 2 cm.) empty glumes (*a*) and pubescent flowering glumes (*b*) 12 to 18 mm. long. Awns nearly twice as long as the spikelets.—Fields and waste places from Minnesota westward; abundant in grain fields on the Pacific slope. [Introduced from Europe.] June–September.

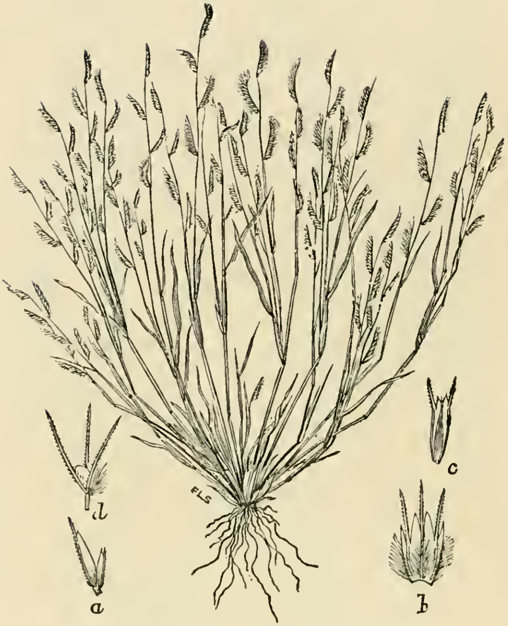

Fig. 500. **Bouteloua polystachya** (Benth.) Torr. in Pacif. Rail. Rep. **5** : 366, t. 10. 1857. (*Chondrosium polystachyum* Benth. Bot. Voy. Sulph. 56. 1844.) Six-weeks Grama.—A slender and diffusely spreading, much-branched annual, 1 to 4 dm. high, with short, narrow leaves and 3 to 6 linear spikes about 2 cm. long, approximate near the apex of the culm or its branches. Spikelets with glabrous, unequal empty glumes (*a*), the larger second one 1.5 mm. long, and 4-lobed flowering glumes (*b*), which are awned between the lobes and ciliate on the nerves.—River valleys, etc., Utah to Texas and westward to southern California. [Mexico.] July–September.

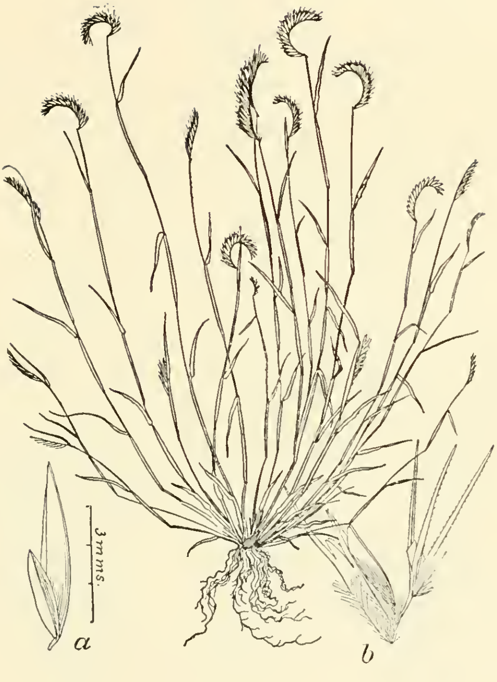

FIG. 501. **Bouteloua prostrata** Lag. Varied. Cienc. 2^4 : 141. 1805. TUFTED GRAMA.—A slender, tufted annual, 1 to 2 dm. high, with short, narrow leaves and solitary, curved, terminal spikes 1.5 to 2 cm. long. Spikelets with very unequal, glabrous empty glumes (*a*), the second about 4 mm. long, and broadly oblong, 3-lobed and 3-awned flowering glumes which are pubescent on the back below.—Common on bottom lands, New Mexico, Colorado, and (?) Arizona. [Mexico.] June-October.

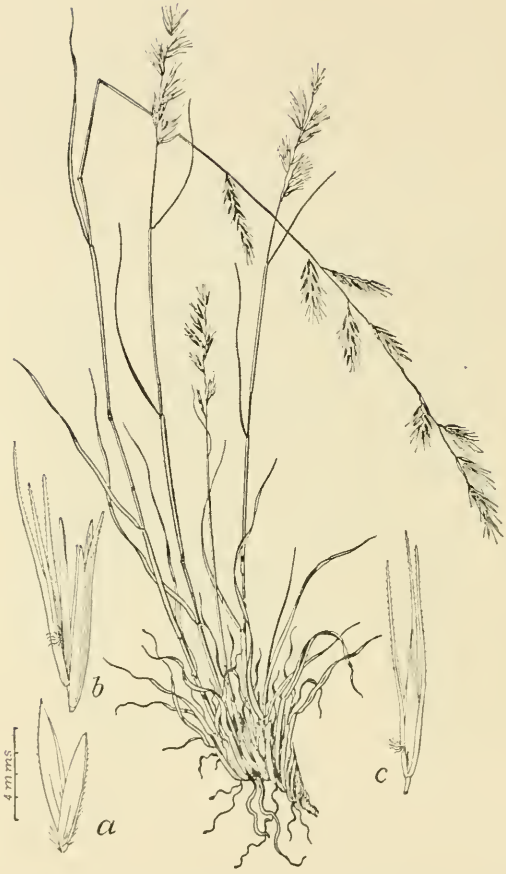

FIG. 502. **Bouteloua bromoides** Lag. Gen. Sp. Nov. 5. 1816. (*Dinebra bromoides* H. B. K.) SPRUCE-TOP.—A rather stout, erect perennial 3 to 6 dm. high, with flat leaves and 5 to 7 more or less spreading spikes, racemose along the upper portion of the culm. Spikelets 5 to 11 in each spike; flowering glume 5 to 6 mm. long, with 3 short awns; imperfect floret (*c*) raised on a short stipe, and with 3 long awns and a palea.—New Mexico and Arizona. [Mexico.] August, September.

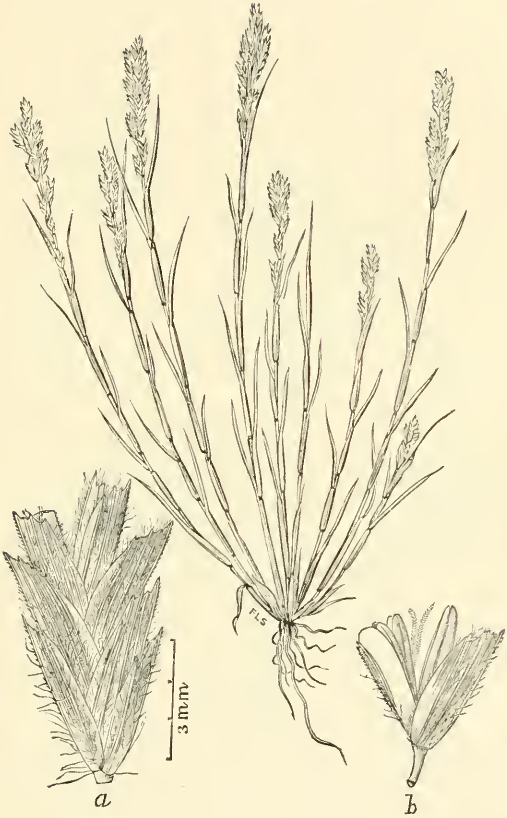

FIG. 503. **Orcuttia greenii** Vasey, Coult. Bot. Gaz. **16** : 146. 1891; Ill. N. Am. Grasses, **2** : 50. CHICO GRASS.—A rigid, cæspitose, and more or less branching, leafy annual 1 to 2.5 dm. high, with narrow and rather densely flowered spikes 2 to 6 cm. long. Spikelets (*a*) compressed, 8 to 12 mm. long, 9- to 15-flowered, with many-nerved, papillate-pilose and dentate glumes.—Chico, Cal. June.

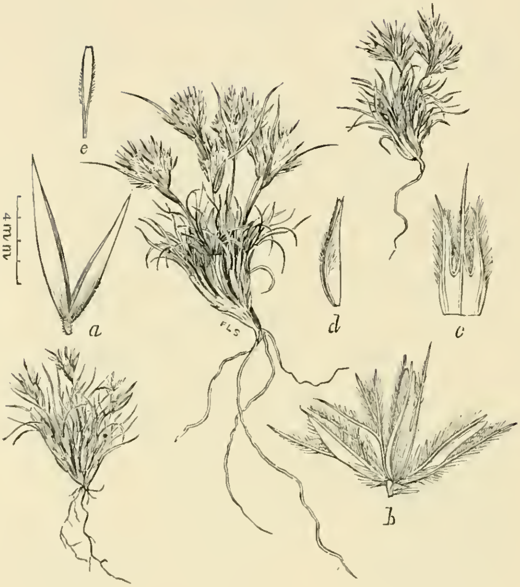

Fig. 504. **Blepharidachne kingii** (S. Wats.) Hackel in DC. Monog. Phan. **6** : 261. 1889. (*Eremochloë kingii* S. Wats. in Bot. King's Exped. 382, t. 40. 1871.) King's Desert-grass.—A low, densely tufted perennial 0.2 to 0.6 dm. high, with numerous short, spreading, recurved leaves and densely flowered, subcapitate panicles partly inclosed in the upper leaf-sheaths. Spikelets about 3-flowered, with lanceolate, acute empty glumes (*a*) 6 to 7 mm. long. Flowering glumes (*b*) densely hairy at the base and along the keel and marginal nerves, the nerves extending into short awns, the middle one longest (*c*).—Dry foothills in the deserts of Nevada and Arizona. April–July.

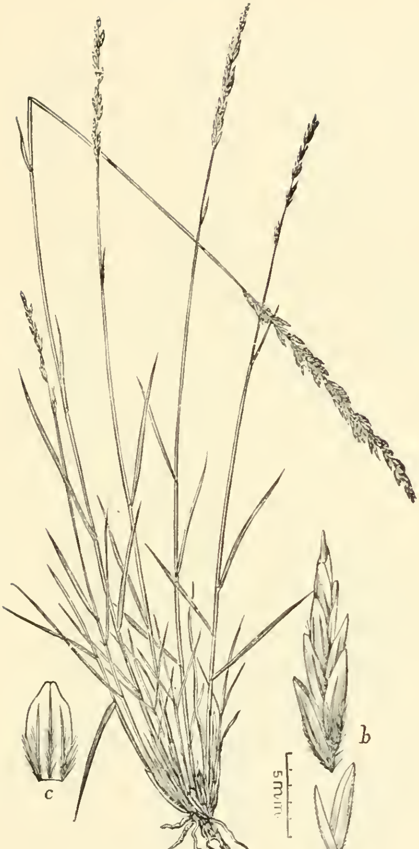

FIG. 505. **Triodia mutica** (Torr.) Scribn. Bull. Torr. Bot. Club **10**: 30. 1883. (*Tricuspis mutica* Torr. Pac. R. Ry. Rept. **4**: 156. 1857.) SLENDER TRIODIA.—A slender, wiry, erect perennial 3 to 5 dm. high, with short, narrow leaves and contracted panicles 10 to 20 cm. long. Spikelets 5- to 8-flowered, 8 to 10 mm. long, with obtuse or emarginate flowering glumes (*c*) which are pubescent on the keel and marginal nerves near the base.—Dry hillsides, Texas and Arizona. [Mexico.] April-October.

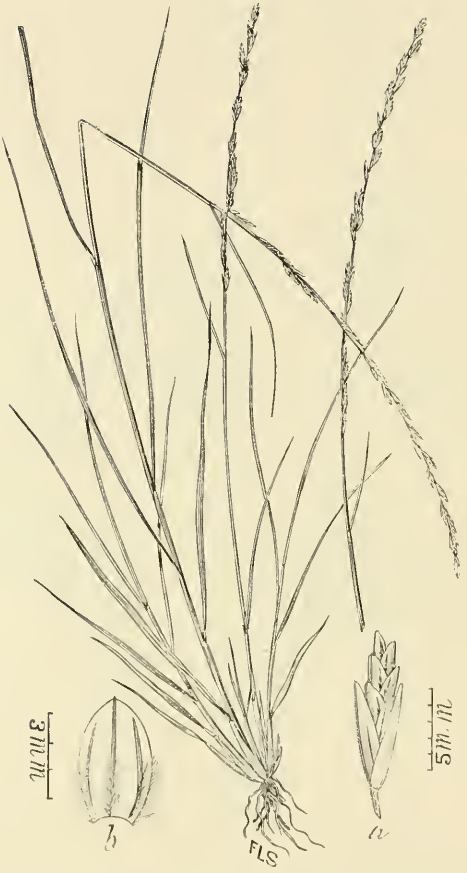

Fig. 506. **Triodia trinerviglumis** Vasey, Ill. N. Am. Grasses. 1^2 : No. 40. 1891. Wiry Triodia.—A slender, erect, cæspitose perennial 6 to 10 cm. high, with narrow leaves and contracted, spike-like panicles 8 to 16 cm. long. Spikelets 7- to 9-flowered, 6 to 10 mm. long; flowering glumes (*b*) 4 to 5 mm. long and pubescent on the nerves below.—Dry soil, Missouri to Arkansas and west to Colorado and Arizona. June–September.

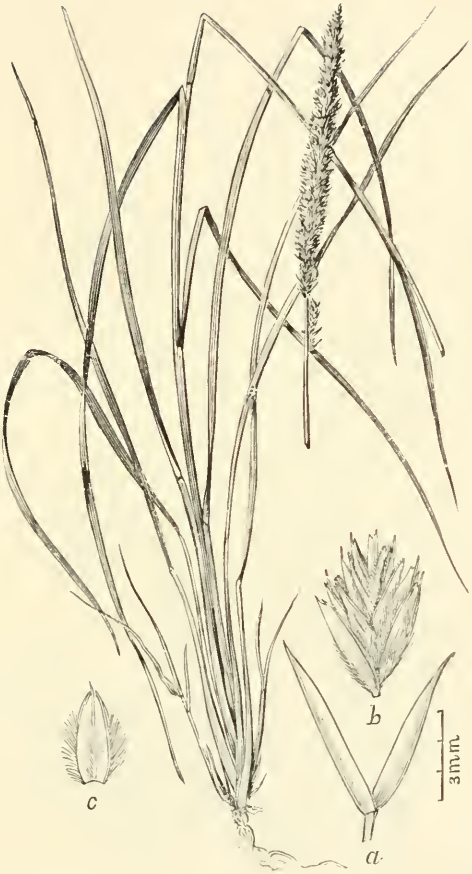

Fig. 507. **Triodia stricta** (Nutt.) Vasey, Ill. N. Am. Grasses 1^2:, No. 38. 1891. (*Windsoria stricta* Nutt.) Spiked Triodia.—A stout, erect, cæspitose perennial 12 to 14 dm. high, with rather long, rigid leaves and densely flowered, spike-like panicles 10 to 30 cm. long. Spikelets nearly sessile, 5- to 8-flowered, 4 to 5 mm. long, with lanceolate, acute empty glumes (*a*) and oblong, obtuse flowering glumes (*c*) which are 2 to 3 mm. long.—Moist soil, Louisiana and Mississippi to Kansas and Texas. August–October.

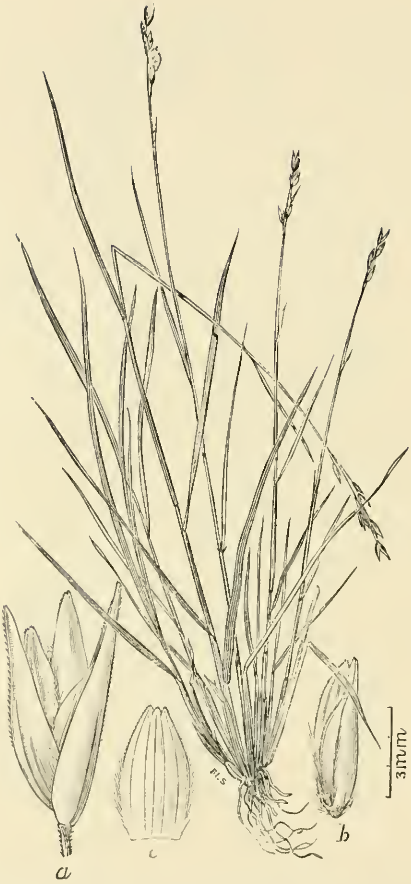

FIG. 508. **Sieglingia decumbens** Bernh. Syst. Verz. d. Erfurth. Pfl. 40. 1800. (*Triodia decumbens* Beauv. Agrost. 67. 1812. *Festuca decumbens* Linn.) HEATHER-GRASS.—An erect or often decumbent, glabrous perennial, with narrow leaves and simple, contracted panicles 2 to 4 cm. long. Spikelets (*a*) 3- to 5-flowered, 6 to 10 mm. long, with acute empty glumes and obtusely 3-toothed flowering glumes (*c*) which are ciliate on the margins below.—Newfoundland. Introduced. [Europe, Asia.] August, September.

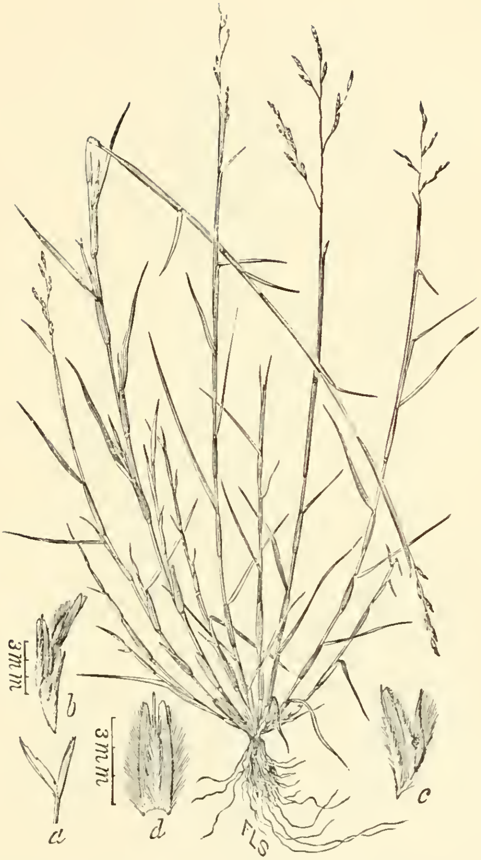

FIG. 509. **Triplasis purpurea** (Walt.) Chap. Fl. So. St. 559. (*Aira purpurea* Walt. Fl. Car. 78. 1788. *Tricuspis purpurea* A. Gray; *Sieglingia purpurea* Kuntze.) PURPLE SAND-GRASS.—A smooth, erect or spreading, cæspitose perennial 3 to 9 dm. high, with narrow, rigid leaves and simple panicles 2 to 6 cm. long. Spikelets 2- to 5-flowered, 5 to 8 mm. long, with smooth empty glumes (*a*) and hairy, 2-lobed and short-awned flowering glumes (*d*).—In sandy soil along the coast, from Maine to Florida and westward to Nebraska and Texas. July–October.

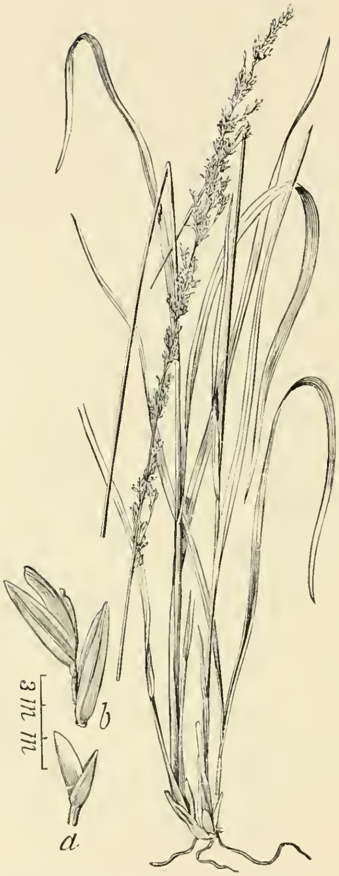

Fig. 510. **Molinia cærulea** (L.) Moench, Meth. 183. 1794. (*Aira cærulea* L. Sp. Pl. 63; *Enodium cæruleum* Gaud.) Molinia.—A rather coarse and rigid perennial 6 to 10 dm. high, with rather stiff leaves and narrow, usually purplish panicles 15 to 30 cm. long. Spikelets 2- to 4-flowered, 5 to 8 mm. long, with obtuse, 3-nerved flowering glumes about 4 mm. long.—Sparingly introduced by ships' ballast and in waste places. [Europe.] August, September.

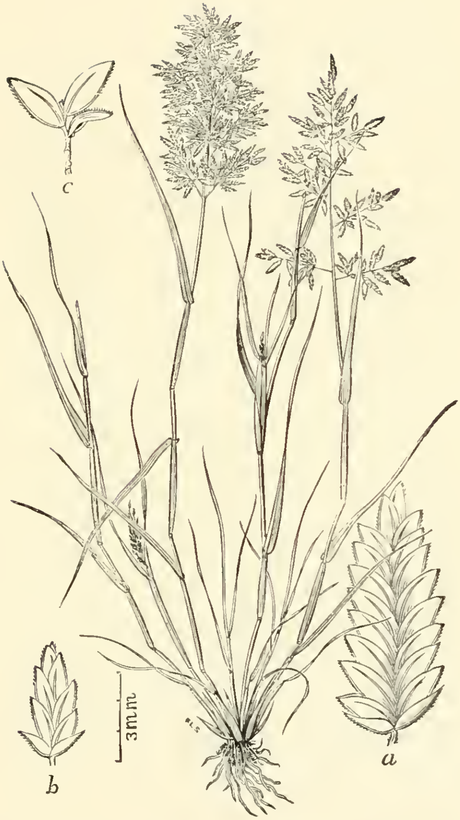

FIG. 511. **Eragrostis** major Host, Gram. Austr. **4**: 14, pl. 24. 1809. (*Eragrostis poaoides* var. *megastachya* A. Gray.) CANDY-GRASS.—A rather showy, much-branched annual, with erect or ascending stems 1.5 to 9 dm. high. Spikelets (*a*, *b*) 5- to 40-flowered, 5 to 16 mm. long and about 3 mm. wide.—Naturalized in cultivated or waste ground, usually in sandy soil, almost everywhere in the United States and in Ontario. [Europe, Asia, naturalized in tropical America.] June–October.

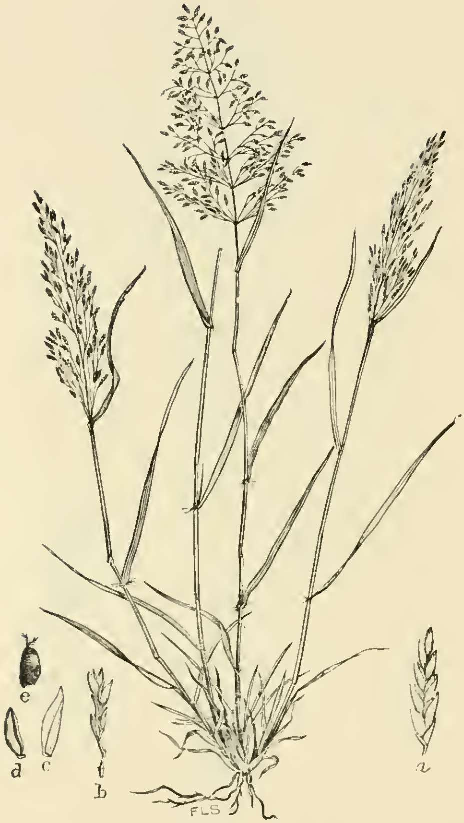

FIG. 512. **Eragrostis pilosa** (Linn.) Beauv. Agrost. 162. 1812. (*Poa pilosa* L. Sp. Pl. 68.) SLENDER MEADOW-GRASS.—A slender, branching annual 1.5 to 4.5 dm. high, with narrow, flat leaf-blades and open, capillary panicles of small, appressed, 5- to 12-flowered spikelets (*a*) 3 to 6 mm. long.—In cultivated fields, roadsides, and sandy shores, Massachusetts to Illinois and Kansas, south to Florida, Texas, and Arizona. [Widely distributed in tropical and warm temperate countries.] June-September.

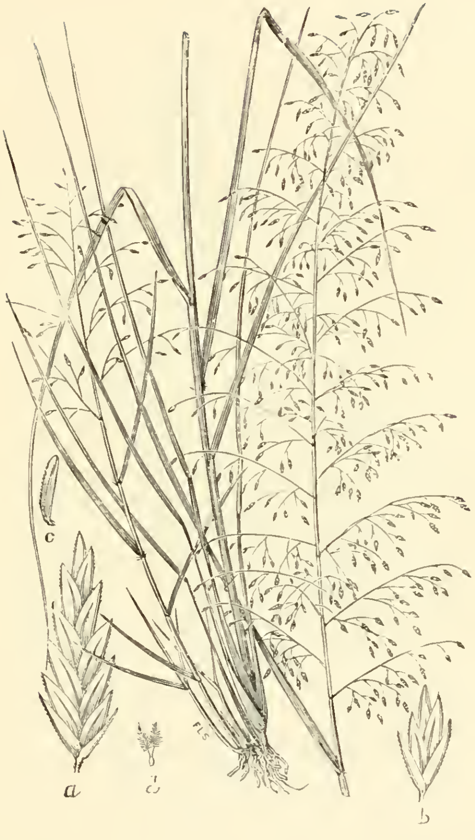

Fig. 513. **Eragrostis trichodes** (Nutt.) Nash, Bull. Torr. Bot. Club **22**:465. 1895. (*Poa trichodes* Nutt.; *Eragrostis tenuis* A. Gray, not Steud.) Branching Spear-grass.—A tall perennial 6 to 15 dm. high, with rather narrow, elongated, many-flowered panicles and somewhat rigid leaves. Spikelets 3- to 10-flowered, 5 to 10 mm. long, with acute glumes.—Sand-hills and prairies, Illinois to Nebraska, Indian Territory and Texas. July–September.

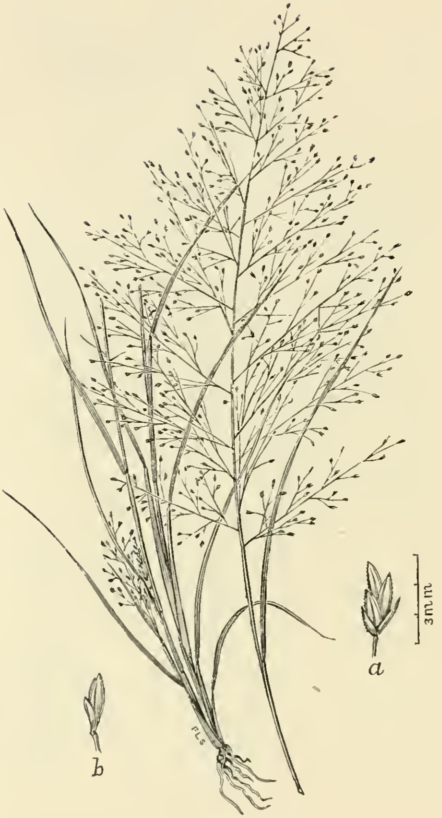

FIG. 514. **Eragrostis capillaris** Nees, Agrost. Bras. 505. 1829. (*Poa capillaris* Linn. Sp. Pl. 68; *Poa tenuis* Ell.) LACE-GRASS.—An erect annual, 15 to 60 cm. high, branching at the base, with an oblong-ovoid, widely expanded panicle of very small 2- to 4-flowered spikelets, 2 to 3 mm. long.—Dry, sandy fields and roadsides, Rhode Island to Illinois and Missouri, south to Georgia and Texas. August, September.

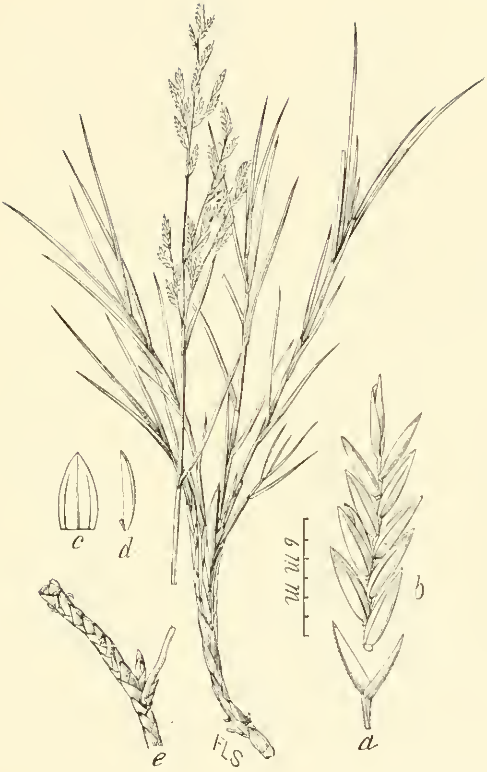

FIG. 515. **Eragrostis obtusiflora** Scribn. U. S. Dept. Agr., Div. Agros. Bull. **8**: 10, Plate 5. May, 1897. MEXICAN SALT-GRASS.—A rigid, erect, branching perennial 3 to 5 dm. high, from strong, scaly rootstocks, with stiff, pungent-pointed leaves, and more or less spreading panicles 8 to 14 cm. long. Spikelets 5- to 12-flowered, 7 to 15 mm. long, the rigid flowering glumes obtuse and about 4.5 mm. long.—Sandy, alkaline soil, Arizona. Resembles salt-grass (*Distichlis spicata*) in habit. August, September

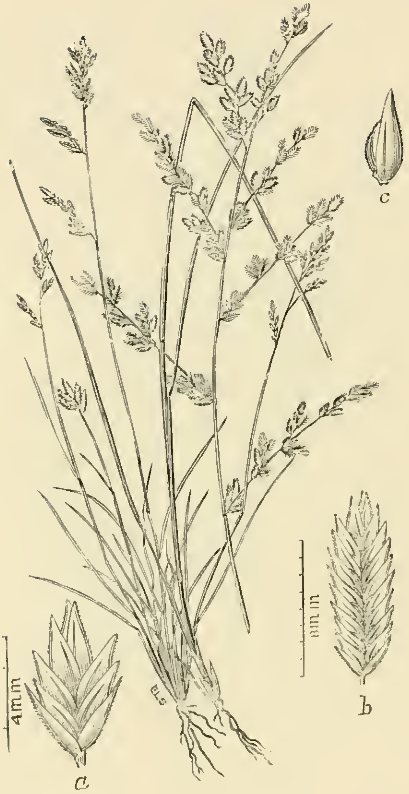

FIG. 516. **Eragrostis secundiflora** Presl, Reliq. Haenk. **1**: 276. 1830. (*Eragrostis oxylepis* Torr.; *Poa interrupta* Nutt. not Lam.) PURPLE LOVE-GRASS.—A smooth perennial 1.5 to 9 dm. high, with rather rigid, narrow leaves and contracted or open panicles 3 to 12 cm. long. Spikelets (*a*, *b*) crowded, strongly compressed, 8- to 40-flowered, 6 to 20 mm. long, with acute glumes.—Dry soil, Florida, Alabama and westward to Kansas, Indian Territory, Texas, and California. [Mexico and Central America.] July–November.

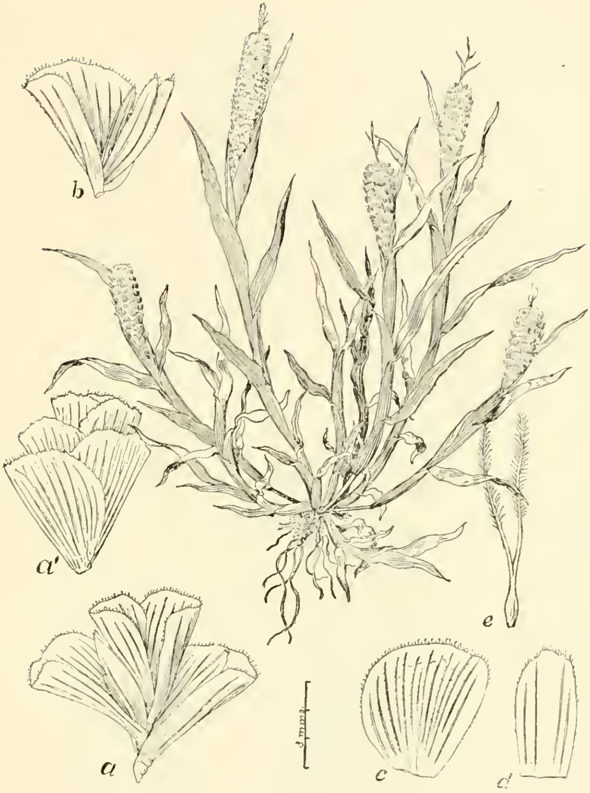

FIG. 517. **Anthochloa colusana** (Davy), Scribner, n. comb. (*Stapfia colusana* Davy, Eryth. **6**: 110. 1898; *Neostapfia colusana* Davy, Eryth. **7**: 43. 1899.)—A densely cæspitose, spreading or ascending, glabrous annual (?) with loose sheaths, rather short, flat leaves, and densely flowered, oblong or cylindrical, spike-like panicles 3 to 7 cm. long. Spikelets (*a*) usually 3- to 5-flowered, 6 to 7 mm. long, with very broad, flabelliform, ciliate-fringed flowering glumes (*c*) about 5 mm. long. Lower empty glumes, when present, narrowly lanceolate.—Uncultivated alkali "goose-lands." Colusa County, California.

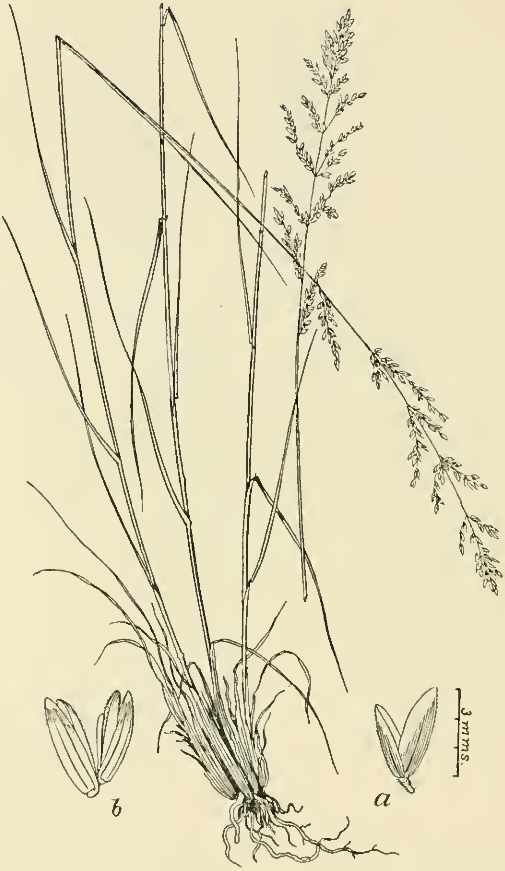

FIG. 518. **Melica imperfecta** Trin. Gram. Suppl. Bull. Sc. Acad. St. Petersb. **1**:68. 1836; Icon. Gram. t. 355. (*M. colpodioides* Nees; *M. panicoides* Nutt.) SMALL-FLOWERED MELIC-GRASS.—A somewhat slender, erect perennial 6 to 9 dm. high, with narrow, flat leaves and more or less diffusely spreading, many-flowered panicles. Spikelets 1- to 2-flowered, 3 to 5 mm. long, with the empty glumes (*a*) shorter than the spikelet; rudimentary floret sessile or nearly so.—Hillsides and grassy mountain slopes, California. [Lower California.] March–July.

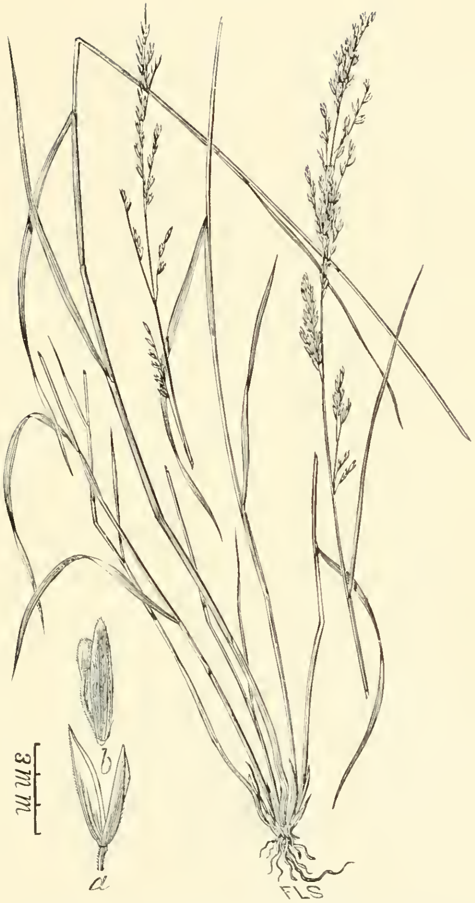

FIG. 519. **Melica torreyana** Scribn. **Proc.** Acad. Nat. Sci. Phila. 1885:47. TORREY'S MELIC-GRASS.—A slender, leafy, cæspitose perennial 6 to 9 dm. high, with flat leaves and more or less spreading panicles 12 to 20 cm. long. Spikelets usually 1-flowered, with the rudiment of a second flower raised upon a long pedicel; empty glumes (*a*) as long as or exceeding the flowering glume, which is minutely pubescent toward the apex.—California. May–September.

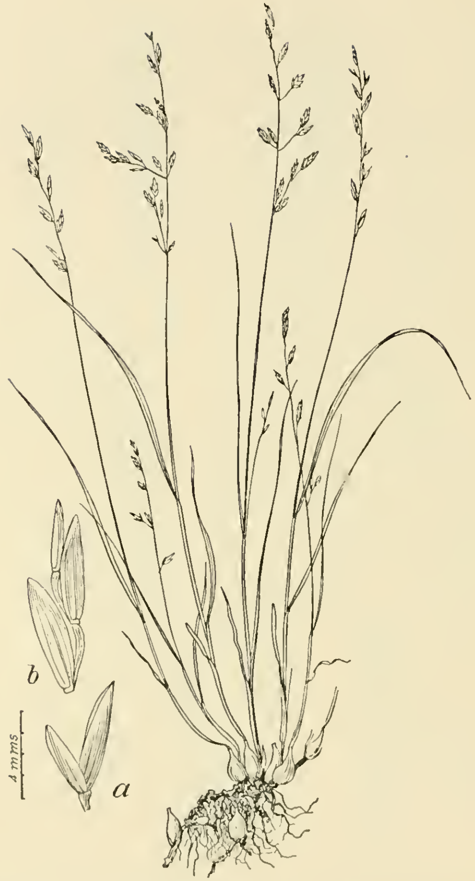

FIG. 520. **Melica fugax** Boland. Proc. Calif. Acad. Sci. **4**: 104. 1870; Vasey, Ill. N. Amer. Grasses **2**: Pl. LXV. SMALL MELIC-GRASS.—A slender, erect perennial, 1.5 to 3.5 dm. high, from a bulbous base, with flat leaves and few-flowered, narrow panicles 8 to 16 cm. long. Spikelets 6 to 8 mm. long, 3- to 5-flowered; glumes obtuse, the floral ones about 4 mm. long.—Low grounds in open pine woods, dry mountain sides, etc., Washington to California. May–June.

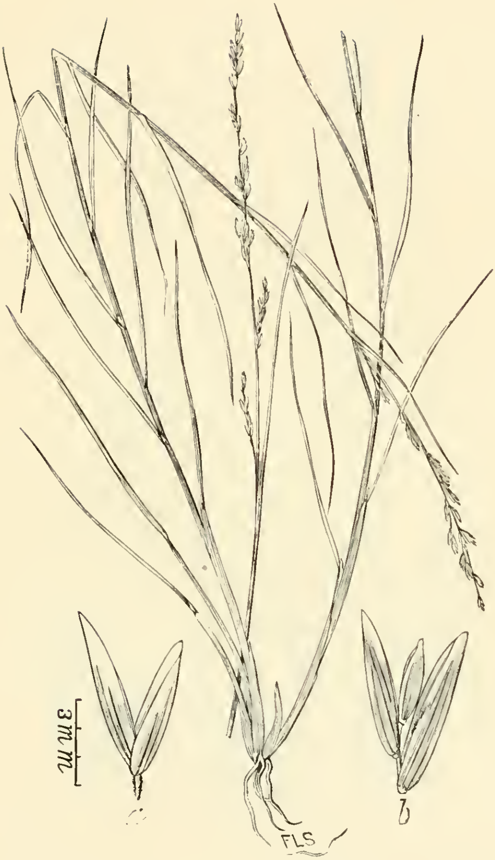

FIG. 521. **Melica longiligula** Scribn. & Kearney, sp. nov.—A slender, erect, cæspitose perennial, 6 to 7 dm. high, with narrow leaves, and strict, more or less interrupted panicles 15 to 20 cm. long. Spikelets 3- to 5-flowered, 6 to 8 mm. long, on short, pubescent pedicels; glumes obtuse, minutely scabrous, the outer ones unequal, the larger second one 5 to 5.5 mm. long; the first flowerering glume 5 to 6 mm. long. Ligule 5 to 6 mm. long.—Southern California (No. 865. Parish Brothers, 1881).

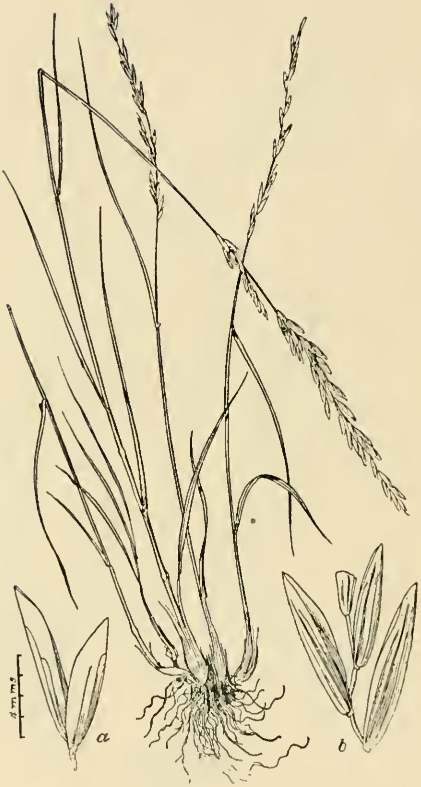

Fig. 522. **Melica californica** Scribn. Proc. Acad. Nat. Sci. Phila. 1885: 46. (*M. poæoides* Torr. in Pacif. R. Ry. Rep. 4 : 157, not Nutt.; *M. bulbosa* Thurb. in Brewer and S. Wats. Bot. California, **2** : 304, not Geyer). California Melic-grass.—A slender, erect perennial, from a bulb-like base, 3 to 9 dm. high, with very narrow leaves and contracted, densely flowered panicles 8 to 16 cm. long. Spikelets about 8 to 10 mm. long, usually with three perfect flowers; flowering glumes obtuse, the first one about 8 mm. long.—Dry slopes and ridges, California. April–June.

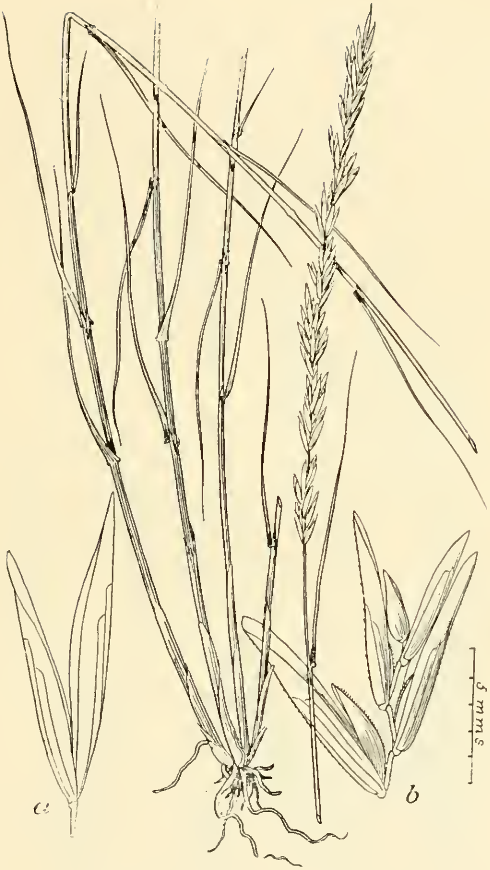

FIG. 523. **Melica frutescens** Scribn. Proc. Acad. Nat. Sci. Phila. 1885: 45, pl. 1, figs. 15 and 16. WOODY MELIC-GRASS.—A stout, leafy perennial, 6 to 10 dm. high, somewhat woody at the base, with flat, scabrous leaves and rather densely-flowered, strict panicles 10 to 30 cm. long. Spikelets usually 5-flowered, about 12 mm. long, with the empty glumes (*a*) nearly as long, the first floral glume obtuse, and about 8 mm. long.—Southern California. [Lower California, Mexico.] April–June.

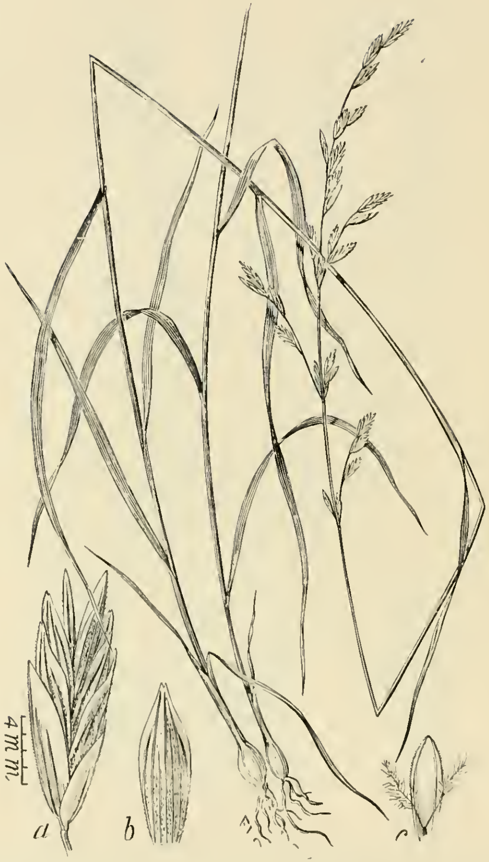

Fig. 524. **Melica inflata** Vasey, Contrib. Nat. Herb. **1**: 269. 1893. Inflated Melic-grass.—An erect, leafy perennial, 9 to 18 dm. high, bulbous at the base, with spreading, simple panicles 12 to 20 cm. long. Spikelets 12 to 18 mm. long, 6- to 8-flowered, with subacute, scabrous flowering glumes (*b*) about 8 mm. long.—Mountains of California. June, July.

Allied to *M. californica*.

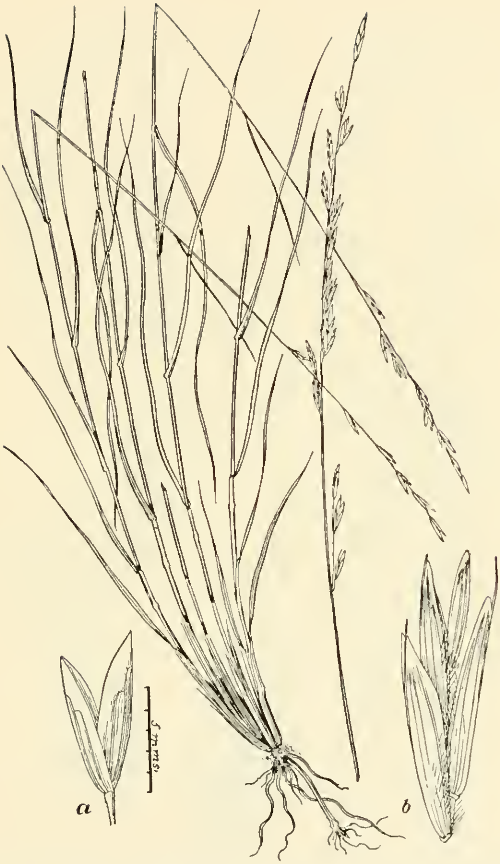

Fig. 525. **Melica harfordii** Boland. Proc. Calif. Acad. Sci. **4**: 102. 1870; Thurb. in Brewer and S. Wats. Bot. California **2**: 305. Harford's Melic-grass.—A rather slender, erect, wiry perennial, 6 to 15 dm. high, with narrow, flat leaves and erect, narrow, light-green or straw-colored panicles, 10 to 20 cm. long. Spikelets 12 to 16 mm. long, 4- to 8-flowered, the flowering glumes 8 mm. long, usually short-awned, and ciliate with long, shining hairs for two-thirds of the margin below.—Mountains of California, Oregon, and Washington. June, July.

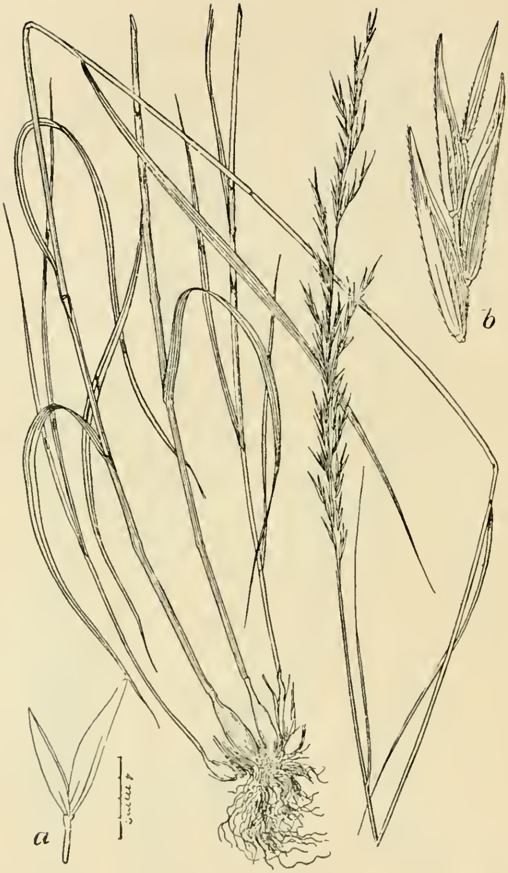

FIG. 526. **Melica subulata** (Bong.) Scribn. Proc. Acad. Nat. Sci. Phila. 1885. 47. (*Festuca subulata* Bong. Veg. Sitch. 173. 1831; *Melica acuminata* Boland.) SLENDER-FLOWERED MELIC-GRASS.—An erect, leafy perennial, 9 to 12 dm. high, from a bulbous base, with flat leaves and rather lax panicles 10 to 20 cm. long. Spikelets 3- to 5-flowered, with long-attenuate pointed flowering glumes, about 12 mm. long, ciliate on the margins and hirsute on the back below.—Shaded canyons and damp woodlands, British Columbia to California, east to Montana. May–September.

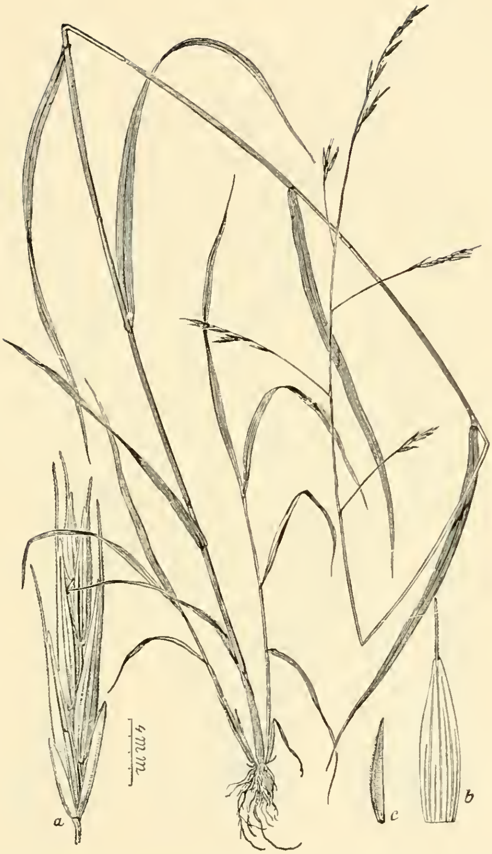

Fig. 527. **Melica smithii** (Porter) Vasey, Bull. Torr. Bot. Club **15** : 294. 1888. (*Avena smithii* T. C. Porter.) Smith's Melic-grass.—A slender, erect perennial, 5 to 10 dm. high, with flat leaves, and spreading panicles 12 to 24 cm. long. Spikelets 3- to 6-flowered, 20 mm. long, with unequal empty glumes and awned, glabrous flowering glumes (*b*) about 10 mm. long. Awn one-fourth to one-half as long as the glume.—Moist woodlands Michigan, Montana, Washington, and British Columbia. June–August.

Allied to *M. aristata*. Thurb.

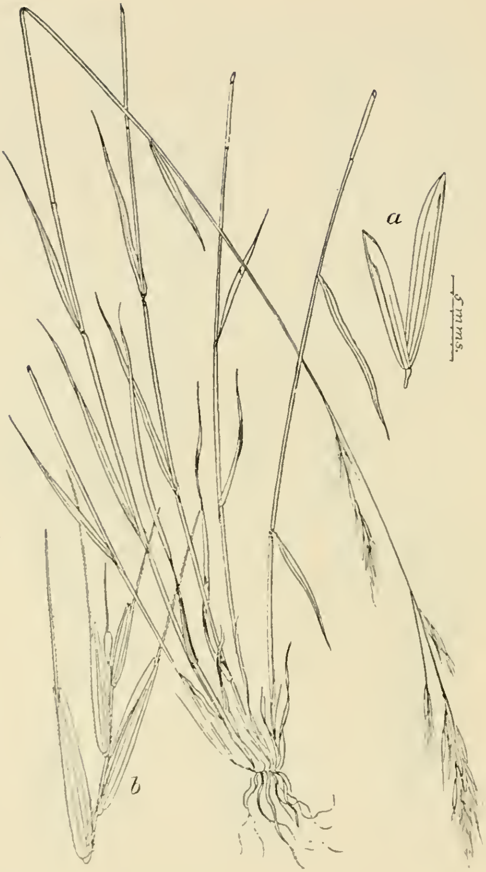

FIG. 528. **Melica aristata** Thurb. in Brew. & Wats. Bot. Calif. **2**:305; Bol. Proc. Calif. Acad. **4**:103. BEARDED MELIC GRASS.—A slender, tufted perennial, 4 to 10 dm. high, with flat, usually pubescent leaves and narrow panicles 10 to 25 cm. long. Spikelets 3- to 5-flowered, with unequal empty glumes (*a*), and awned flowering glumes, which are 10 to 12 mm. long and have a few stiff, marginal hairs near the base. Awn 8 to 14 mm. long.—Washington to California. June, July.

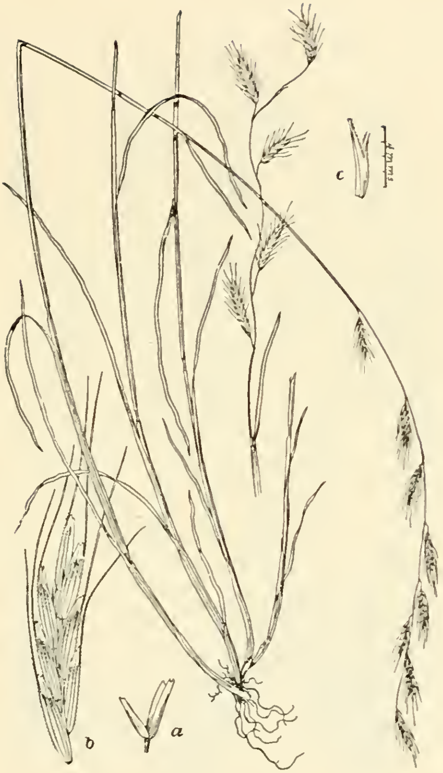

FIG. 529. **Pleuropogon californica** (Nees) Vasey. Ill. N. Am. Grasses **2**: No. 68. 1893; (*Lophochlæna californica* Nees Ann. Nat. Hist. (ser. 1.) **1**: 283. 1838; Hook. & Arnot, Bot. Beechy 403, t. 95.) CALIFORNIA PLEUROPOGON.—A pale green, tufted perennial, with soft or rather weak culms 3 to 6 dm. high, flat leaves, and terminal racemes of 6 to 12 erect or spreading spikelets about 2 cm. long. Flowering glumes scabrous, about 6 mm. long, with a rough awn of nearly equal length.—Low, moist grounds, California. May.

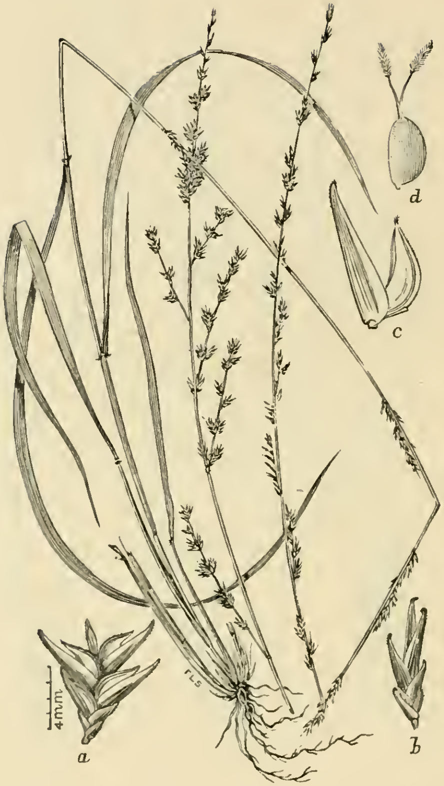

Fig. 530. **Uniola longifolia** Scribn. Bull. Torr. Bot. Club **21**: 229. 1894. Long-leafed Spike-grass.—A rather stout, perennial 6 to 12 dm. high, with long (the lower ones 30 cm.), flat leaves, and narrow panicles 15 to 45 cm. long. Spikelets (*a*) 3- to 4-flowered, 7 to 8 mm. long, with 9- to 11-nerved flowering glumes, 3.5 to 5 mm. long. Lower sheaths more or less pubescent.—In dry soil, low woods, and thickets, or in hummock land, East Tennessee to Florida, Texas, and Indian Territory. June–September.

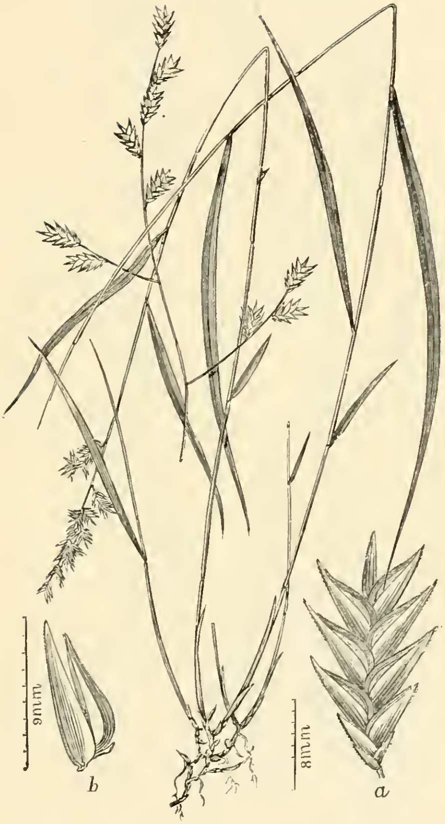

FIG. 531. **Uniola sessiliflora** Poir. Encyc. **8** : 185. 1806. (*Uniola nitida* Ell.). SHORT-STALKED UNIOLA.—A rather slender, wiry perennial 3.5 to 9 dm. high, with flat, spreading leaves, and simple, rigid panicles 5 to 20 cm. long. Spikelets (*a*) strongly flattened, 6- to 8-flowered, 12 to 16 mm. long, with sharply acuminate-pointed empty glumes 6 to 8 mm. long.—On hummocks in shady swamps near the coast, Georgia to Louisiana. June–October.

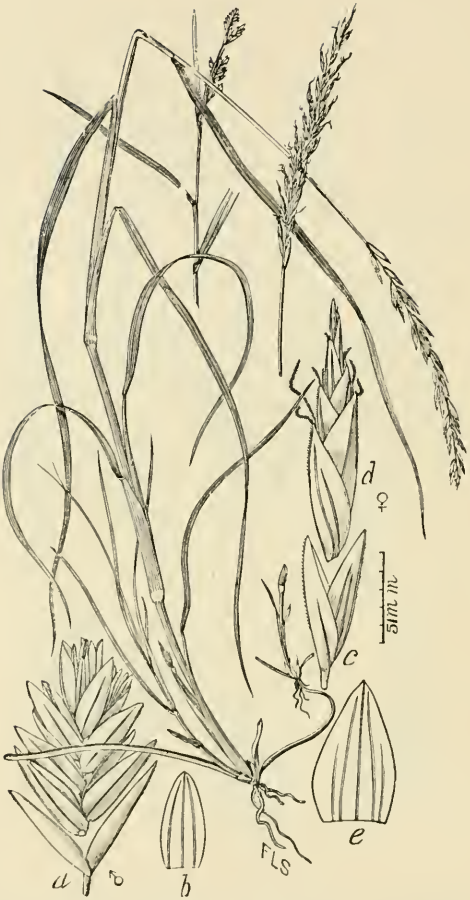

FIG. 532. **Distichlis texana** (Vasey) Scribn. new comb. (*Poa texana* Vasey, Contrib. Nat. Herb. **1**: 60. 1890; *Sieglingia wrightii* Vasey, loc. cit., 269. 1893.)—A rather stout, rigid, glabrous, creeping or stoloniferous perennial 3 to 6 dm. high, with flat leaves and densely flowered, narrow panicles 10 to 20 cm. long. Staminate spikelets (*a*) compressed, 5- to 7-flowered; pistillate spikelets subterete, fusiform, 12 to 25 mm. long.—Western Texas, New Mexico (No. 2038 C. Wright). [Mexico.]

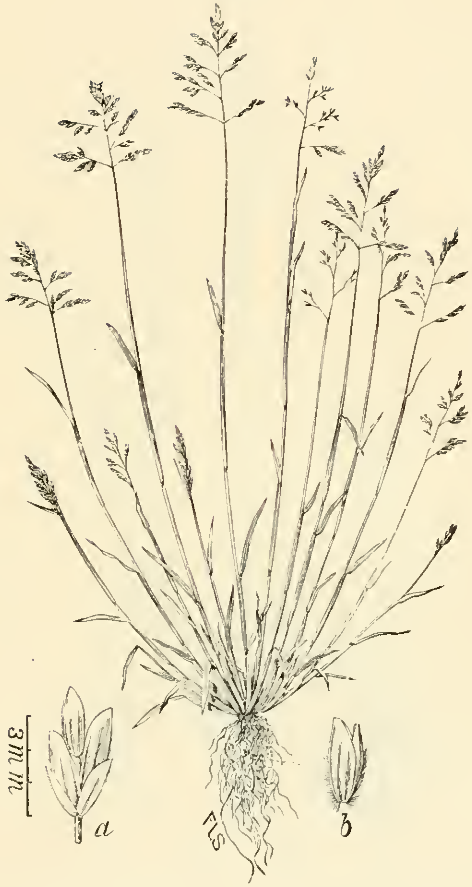

FIG. 533. **Poa annua** Linn. Sp. Pl. 68. LOW SPEAR-GRASS or SUMMER-GRASS.—A low, tufted annual, with erect or ascending, somewhat flattened stems 0.5 to 3 dm. high, smooth, flat, spreading leaves, and short, pyramidal panicles. Spikelets (*a*) 3- to 6-flowered, about 4 mm. long, with slightly unequal empty glumes and obtuse flowering glumes which are hairy on the nerves below and pilose at the base.—Fields and waste places, dooryards, etc., throughout the United States and British America. [Europe.] April–September.

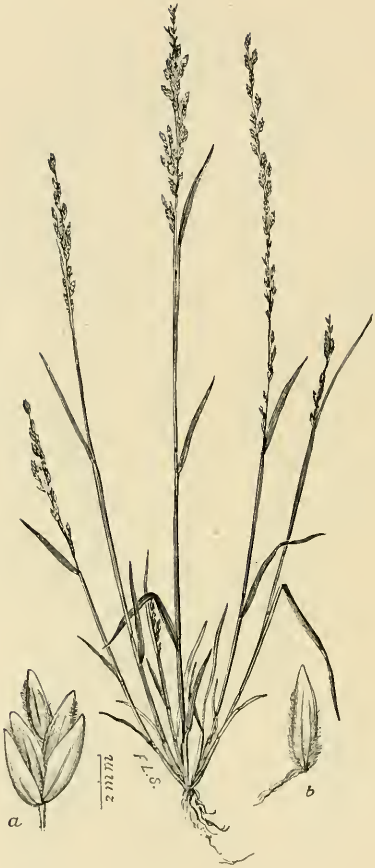

Fig. 534. **Poa bigelovii** Vasey & Scribn. Contrib. U. S. Nat. Herb. **1**: 270. 1893. Bigelow's Blue-grass.—A slender, smooth annual 1 to 6 dm. high, with flat leaves and narrow panicles 4 to 12 cm. long. Spikelets (*a*) 4 to 6 mm. long, 3- to 5-flowered, with the acute empty glumes nearly as long as the flowering ones, which are 3 to 4 mm. long, and villous on the keel and on the lower half of the marginal nerves, with long, cobwebby hairs at the base.—Moist soil, Colorado southward to Texas, New Mexico, Arizona, and California. [Mexico.] April–July.

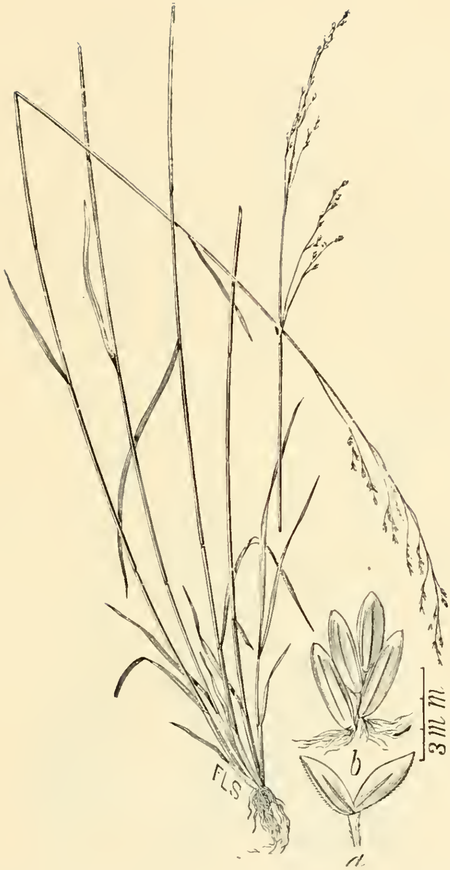

Fig. 535. **Poa debilis** Torr. Fl. N. Y. **2**:459. 1843. Slender Spear-grass.—A slender, erect, smooth perennial 3 to 7 dm. high, with rather short, flat leaves and nodding, few-flowered, open panicles 4 to 12 cm. long. Spikelets 3 to 4 mm. long, 2- to 4-flowered with unequal, acute empty glumes (*a*), broadly obtuse and scarious-tipped flowering glumes which are conspicuously webbed at the base.—In rocky woodlands, Nova Scotia and New Brunswick, southward to Pennsylvania and westward to Minnesota. May–July.

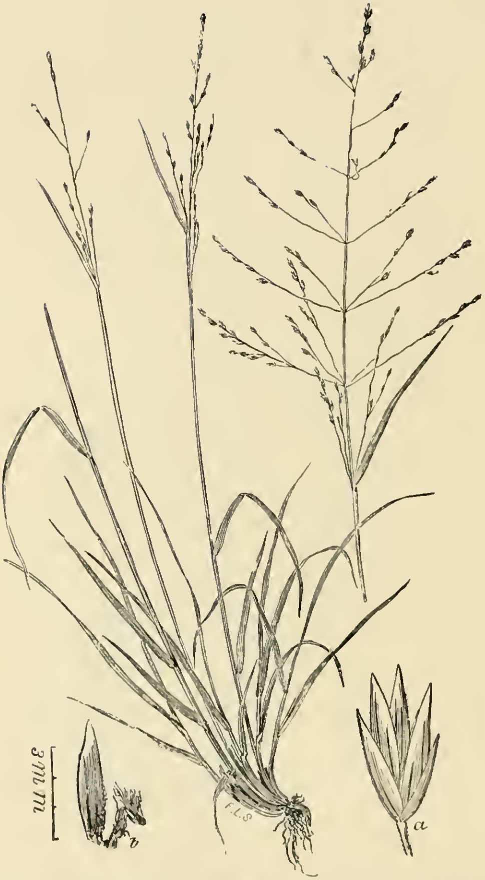

Fig. 536. **Poa alsodes** A. Gray, Man. Ed. 2 : 562. 1856. Woodland Blue-grass.—A slender, erect, smooth perennial 2 to 6 dm. high, with flat leaves and open panicles 9 to 20 cm. long. Spikelets (*a*) 5 mm. long, 2- to 3-flowered, with very acute glumes, the outer ones unequal, the flowering glumes (*b*) about 4 mm. long with a long tuft of cobwebby hairs at the base.—Thickets and open woodlands, Nova Scotia to Ontario and Minnesota, southward to North Carolina and Tennessee. May, June.

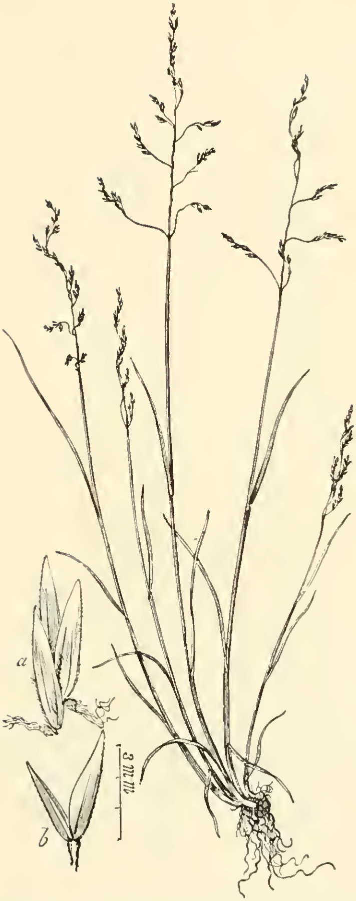

FIG. 537. **Poa leptocoma** Bong. de Veget. ins. Sitch. 170. 1831. SLENDER MOUNTAIN BLUE-GRASS.—A slender, erect perennial, about 3 dm. high, with flat leaves and delicate, open panicles, 4 to 8 cm. long. Spikelets 3-flowered, about 6 mm. long, with slightly unequal empty glumes (*b*) and linear-lanceolate flowering glumes, which are villous on the keel and marginal nerves below, and webbed at the base.—Wet, boggy places, mountains of Colorado, northward to Alaska. July, August.

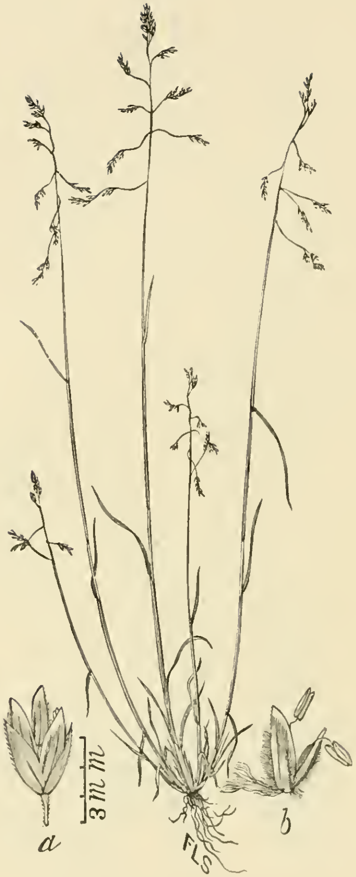

FIG. 538. **Poa reflexa** Vasey & Scribn. Contrib. Nat. Herb., **1**: 276. 1893. NODDING BLUE-GRASS.—A slender, erect perennial, with soft, flat leaves and open, pyramidal panicles with capillary, rather distant and finally reflexed branches. Spikelets (*a*) 3 to 4 mm. long, 2- to 3-flowered; empty glumes nearly equal; flowering glumes ovate-lanceolate, obtuse, pubescent on the middle and lateral nerves, and webbed at the base.—Wet, boggy places, mountains of Wyoming and Colorado to Washington and British America. July, August.

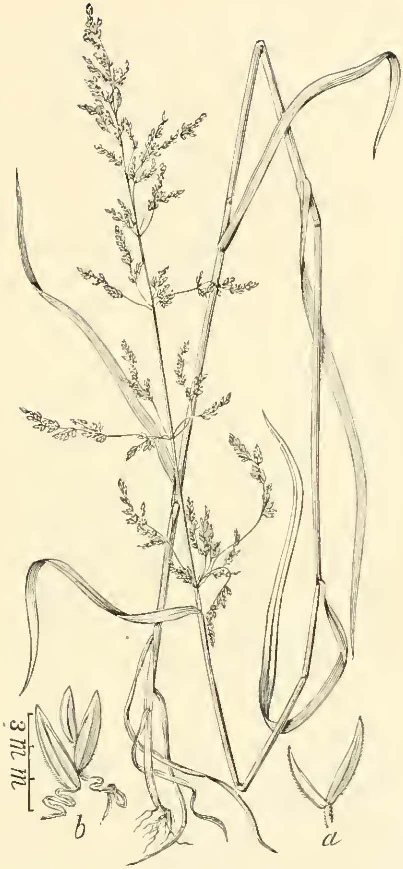

FIG. 539. **Poa trivialis** Linn. Sp. Pl. 67. ROUGH-STALKED MEADOW-GRASS.—An erect, usually slender perennial 3 to 9 dm. high, with flat leaves and open, many-flowered panicles, 6 to 15 cm. long. Culms usually rough near the panicle. Spikelets 2- to 3-flowered, about 3 mm. long, with very acute empty glumes (*a*), and strongly 5-nerved flowering glumes, silky-pubescent on the keel below and with long, cobwebby hairs at the base.—Meadows and roadsides throughout. [Europe.] May–August.

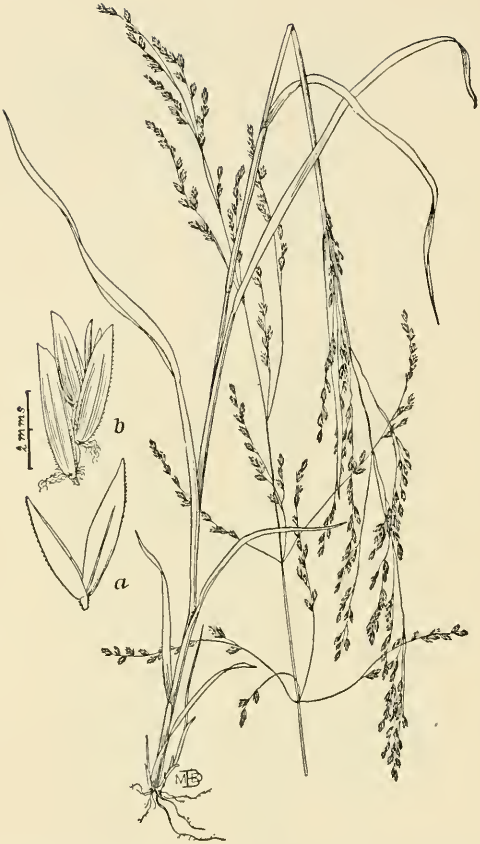

FIG. 540. **Poa occidentalis** Vasey, Contr. Nat. Herb. **1** : 274. 1893. WESTERN BLUE-GRASS.—A slender or somewhat stout, leafy perennial 5 to 8 dm. high, with open, loosely flowered panicles 15 to 30 cm. long. Spikelets 4 to 6 mm. long, mostly 3-flowered, with acute empty glumes and obtuse floral glumes, which are 3 to 4 mm. long and slightly pubescent on the keel below, with a distinct tuft of cobwebby hairs at the base.—In moist soil, New Mexico northward to Colorado and Wyoming; also (?) Alaska. June–September.

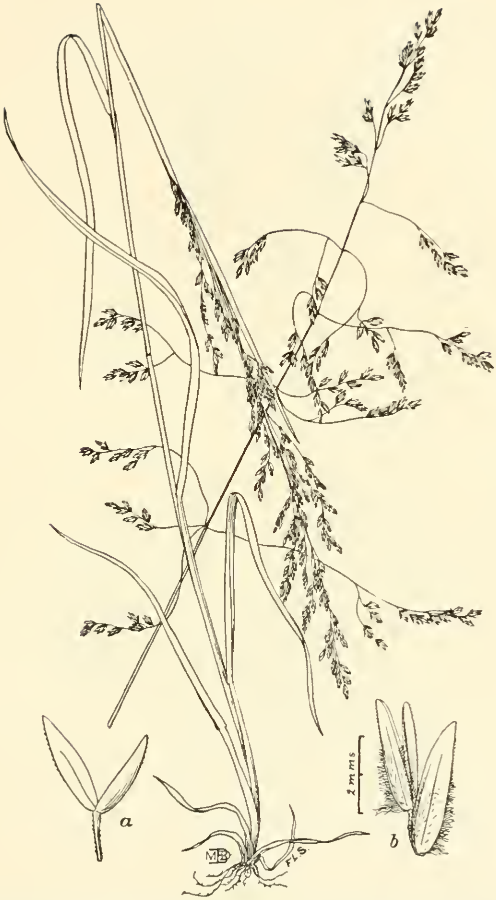

Fig. 541. **Poa tracyi** Vasey, Bull. Torr. Bot. Club, **15**:49. 1888. Tracy's Blue-grass.—A rather stout, erect perennial 5 to 10 dm. high, with flat leaves and open panicles 15 to 25 cm. long. Spikelets clustered near the ends of the branches, 3- to 4-flowered, about 5 mm. long, with obtuse glumes, the floral ones nearly 4 mm. long and white pubescent on the back below, ciliate-hairy on the marginal nerves and keel.—Moist soil, Colorado and New Mexico. June–August.

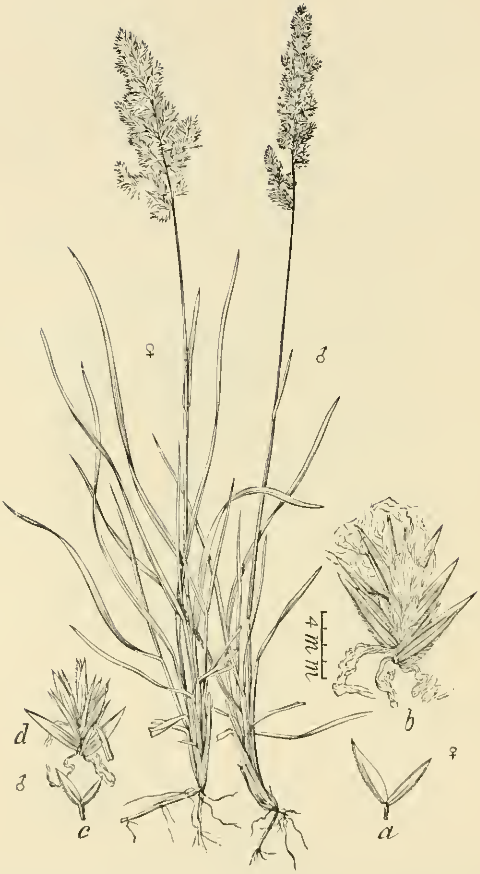

FIG. 542. **Poa arachnifera** Torr. Marcy. Expd. Red Riv. Bot. 301. 1853. TEXAS BLUE-GRASS.—A hardy perennial 3 to 9 dm. high, with strong, creeping rootstocks, long, flat leaves, and narrow, rather densely flowered panicles. Spikelets ovate-lanceolate, 3- to 7-flowered, 4 to 8 mm. long, with acute empty glumes, and (in the fertile plants) very hairy flowering glumes.—A native of Texas, and introduced into cultivation in some of the Southern States. April–June.

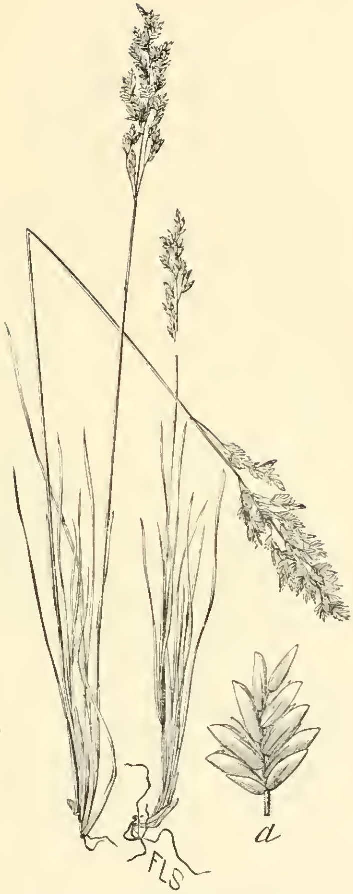

FIG. 543. **Poa fendleriana** (Steud.) Vasey, Ill. N. Am. Grasses, 2 : 74. 1893, in part. (*Eragrostis fendleriana* Steud., Gram, 278. 1855. FENDLER'S BLUE-GRASS. MUTTON GRASS.—An erect, cæspitose perennial 3 to 6 dm. high, with numerous, rather narrow basal leaves and narrow panicles 4 to 8 cm. long. Spikelets 4- to 8-flowered, 7 to 8 mm. long. Flowering glumes pubescent below on the keel and marginal nerves, otherwise smooth.—Mesas and dry hills, Colorado to Arizona and California. April–June.

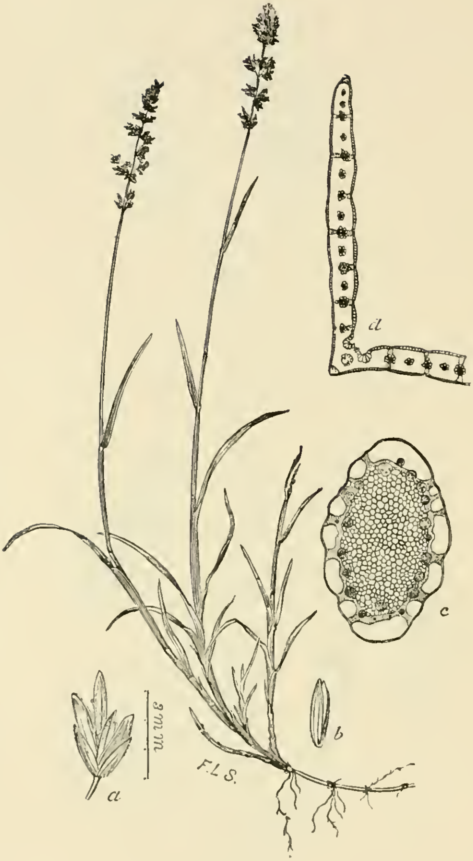

FIG. 544. **Poa compressa** Linn. Sp. Pl. 69. CANADA BLUE-GRASS.—A slender but rather rigid and somewhat wiry perennial, with strongly flattened stems 1.5 to 5 dm. high, and usually small, narrow, few-flowered panicles. Spikelets (*a*) 3- to 5- (rarely 7- to 9-) flowered, 4 to 6 mm. long, with acute 3-nerved empty glumes and rather firm, obscurely nerved flowering glumes 2 to 3 mm. long, sparingly pubescent toward the base.—Dry meadows and waste places, Newfoundland to South Carolina, Tennessee and westward. [Europe.] May–September.

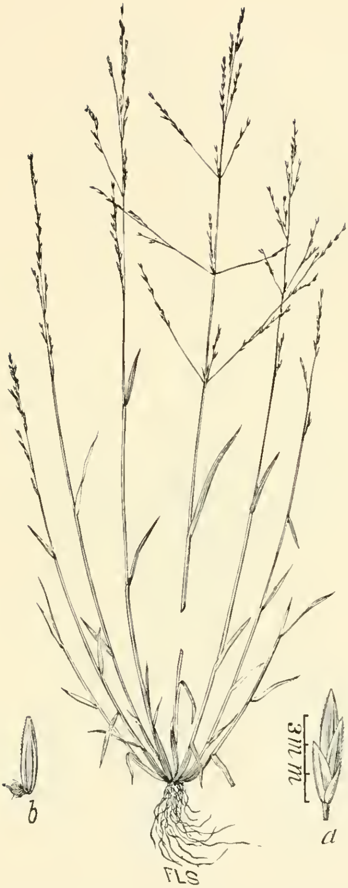

FIG. 545. **Poa bolanderi** Vasey, Coult. Bot. Gaz. **7**: 32. 1882, Ill. N. Am. Grasses, **2** : 73. BOLANDER'S SPEAR-GRASS.—A smooth, loosely tufted, erect perennial 3 to 6 dm. high, with short, flat leaves and spreading panicles 8 to 12 cm. long. Spikelets (*a*) 1- to 3-flowered, 3 to 4 mm. long, with unequal empty glumes and ovate-oblong flowering glumes (*b*), which are about 2.5 mm. long and nearly smooth except for a slight web at the base.—Mountains of California and Oregon. March–August.

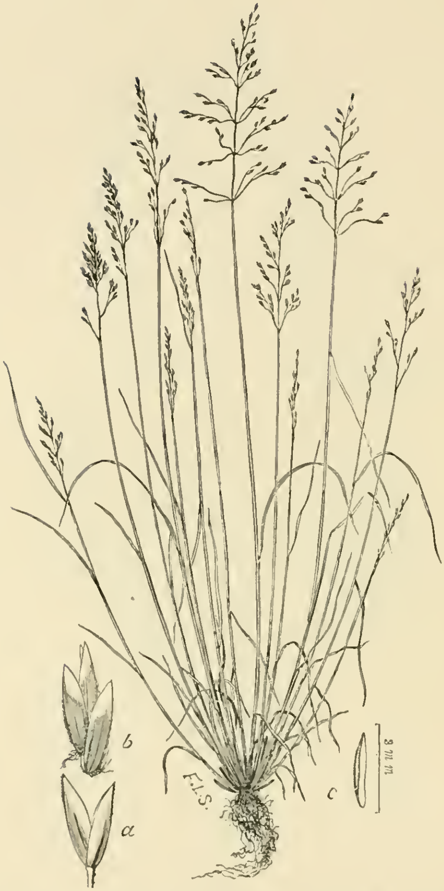

Fig. 516. **Poa nemoralis** Linn. Sp. Pl. 69. Northern Spear-grass or Wood Meadow-grass.—A slender, erect, and rather rigid perennial 1.5 to 6 dm. high, with narrow, flat leaves and usually open panicles 4 to 10 cm. long. Spikelets 2- to 5-flowered, 3 to 5 mm. long, with very acute empty glumes (*a*) and faintly nerved flowering glumes, which are 2 to 3 mm. long and webbed at the base.—Dry or rather moist soil, Labrador and Newfoundland to Pennsylvania, westward to British Columbia, Idaho, and Colorado. [Europe, Asia.] June–September.

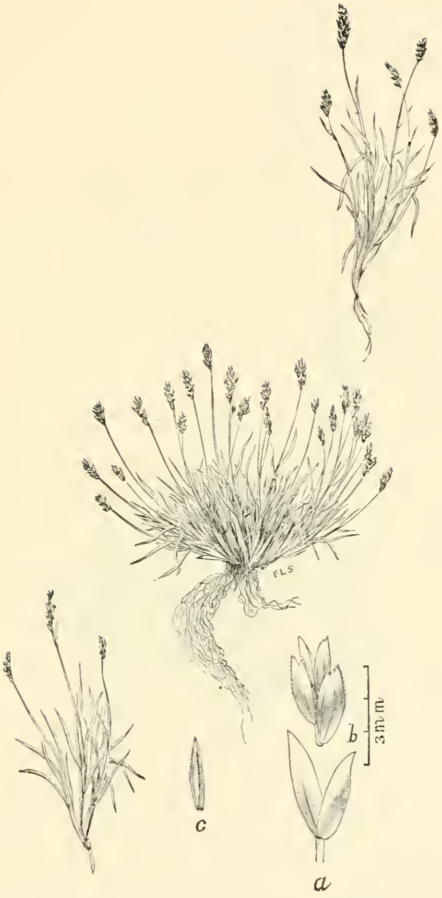

FIG. 547. **Poa lettermani** Vasey, Contrib. Nat. Herb. **1** : 273. 1893. LETTERMAN'S BLUE-GRASS.—A densely tufted, low perennial 0.5 to 1 dm. high, with loose sheaths, short, flat leaves and oblong, rather densely-flowered panicles 1 to 2 cm. long. Spikelets 3 to 4 mm. long, with rather broad and nearly equal empty glumes (*a*) exceeding in length the adjacent flowering glumes, which are 2 to 3 mm. long, obscurely nerved, obtuse, and glabrous.—Summits of high mountains, Colorado. July, August.

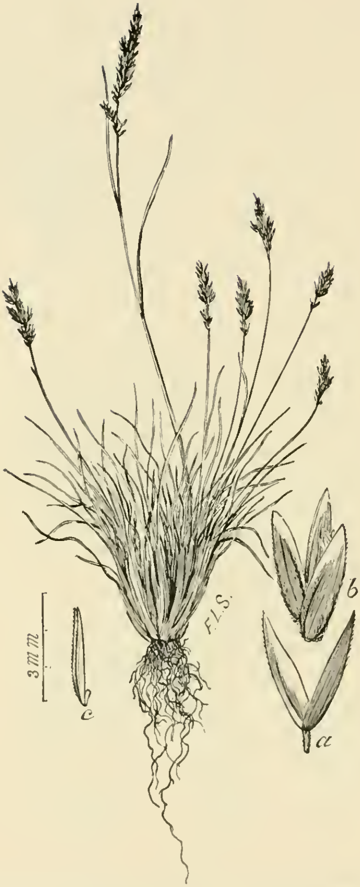

FIG. 548. **Poa pattersoni** Vasey, Contrib. Nat. Herb. **1**:275. 1893. PATTERSON'S BLUE-GRASS.—A low, densely tufted perennial 1 to 1.5 dm. high, with numerous basal leaves, 4 to 6 cm. long and oblong, densely flowered panicles. Spikelets 2- to 3-flowered 4 to 6 mm. long with nearly equal, acute empty glumes nearly as long as the floral ones (4 mm.) which are pubescent on the lateral nerves and keel below the middle but not webbed.—High mountains of Colorado. August.

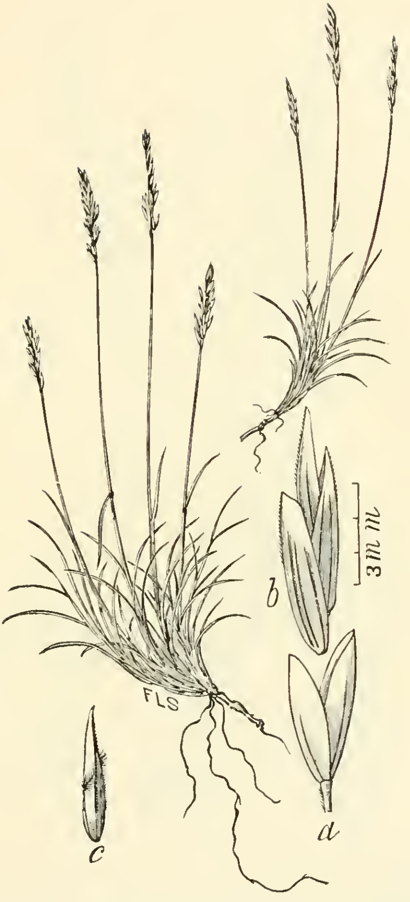

Fig. 549. **Poa pringlei** Scribn. Bull. Torr. Bot. Club **10** : 31. 1883. Pringle's Blue-grass.—A densely tufted perennial from a creeping rootstock, with rather firm, spreading, smooth, narrow leaves and slender, scape-like culms 1 to 1.5 dm. high. Panicles contracted, few-flowered, usually about 2 cm. long. Spikelets 3- to 5-flowered, 6 to 8 mm. long.—Moist places, high mountains, California and (?) Oregon and Washington. August, September.

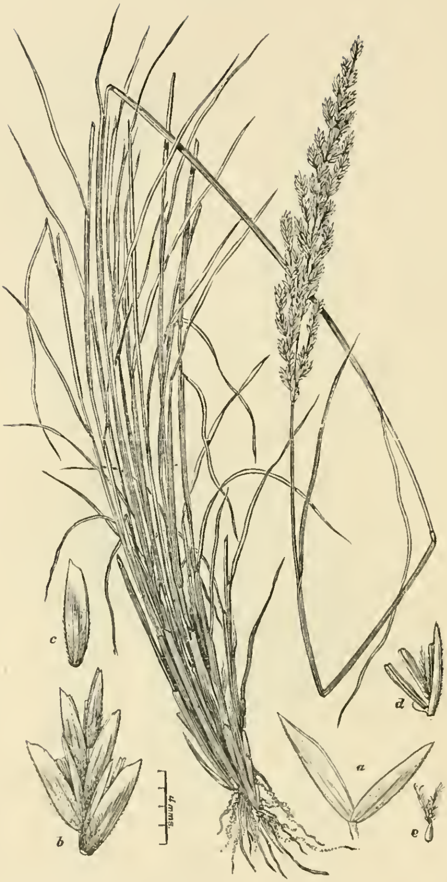

Fig. 550. **Poa leckenbyi** Scribn. U. S. Dept. Agr., Div. Agros., Cir. 9 : 2. 1899. Sand Blue-grass.—A pale green, tufted perennial 6 to 8 dm. high, with long, narrow, flat leaves, somewhat inflated, persistent basal sheaths and pale, rather narrow panicles about 10 to 15 cm. long. Spikelets oblong-lanceolate, 5- to 6-flowered, 9 to 11 mm. long, with subequal, 3-nerved, acute empty glumes (*a*) and scarious-margined flowering glumes (*c*), which are pubescent on the back below, especially on the keel and marginal nerves.—Dry and very sandy soil, Washington. June.

A valuable hay grass for very sandy soils.

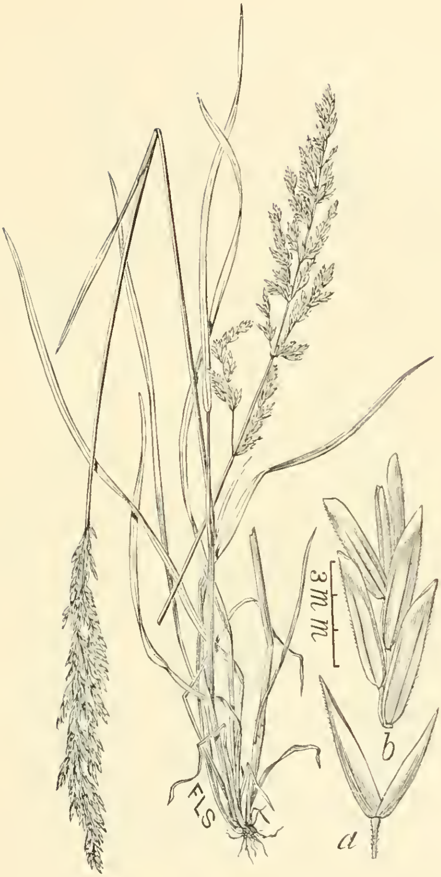

Fig. 551. **Poa nevadensis** Scribn. Bull. Torr. Bot. Club **10**: 66. 1883. Nevada Blue-grass.—An erect, rather stout perennial, with flat leaves and narrow panicles 10 to 25 cm. long. Spikelets lanceolate-oblong, 3- to 8-flowered, 6 to 12 mm. long, with slightly unequal empty glumes (*a*) and oblong-elliptical, usually obtuse, flowering glumes, which are 4 to 5 mm. long and strongly scabrous on the keel.—Moist soil, North Dakota to British Columbia, and southward to Nebraska and Nevada. May–August.

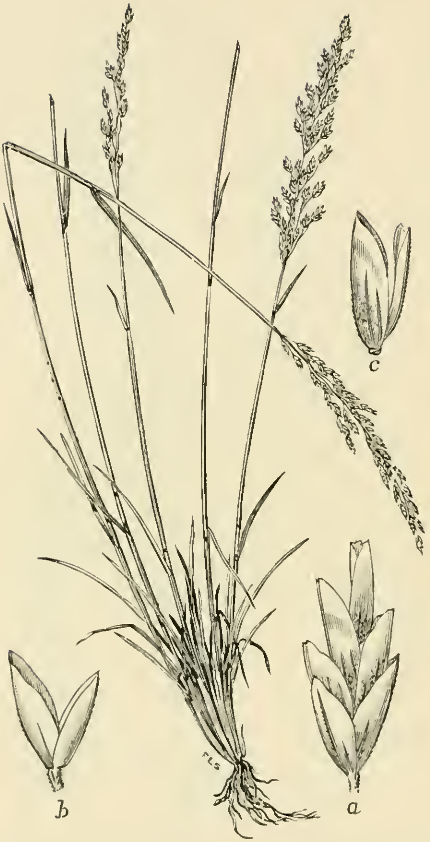

FIG. 552. **Poa lucida** Vasey, Contrib. Nat. Herb. **1**: 274. 1893. YELLOW SPEAR-GRASS.—A slender, tufted perennial, 4 to 6 dm. high, with flat leaves and narrow but lax panicles 10 to 15 cm. long. Spikelets (*a*) 6 to 8 mm. long, 3- to 4-flowered, with obtuse glumes, the flowering ones 4 mm. long and slightly pubescent on the keel and lateral nerves near the base.—Dry, rocky places, moist brooksides, canyons, etc., alt. 1,500–3,300 m.; mountains of Colorado, Wyoming, Montana, and British Columbia. July–September.

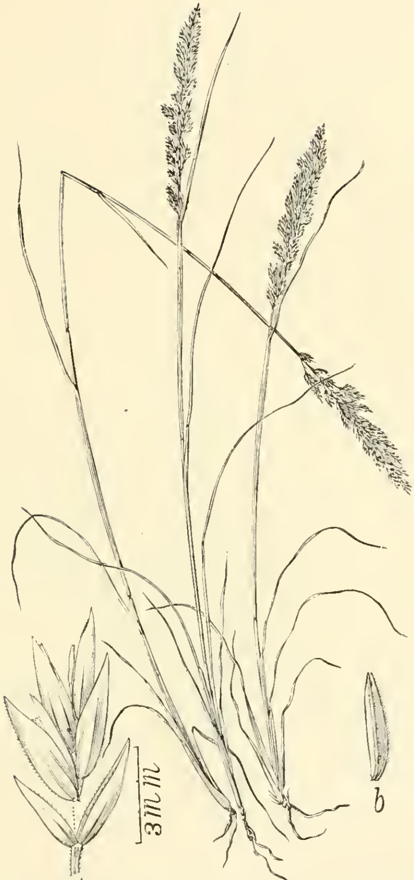

FIG. 553. **Poa unilateralis** Scribn. in Vasey Ill. N. Am. Grasses, 2^2: No. 85. 1893. ONE-SIDED BLUE-GRASS.—An erect, densely tufted, leafy perennial, 2.5 to 5 dm. high, with soft, narrow, basal leaves and densely flowered, usually one-sided panicles 2 to 6 cm. long. Spikelets 4- to 7-flowered, with acute glumes, the floral ones 4 mm. long, a little pubescent near the base, but not webbed.—Bluffs along the coast, California. April, May.

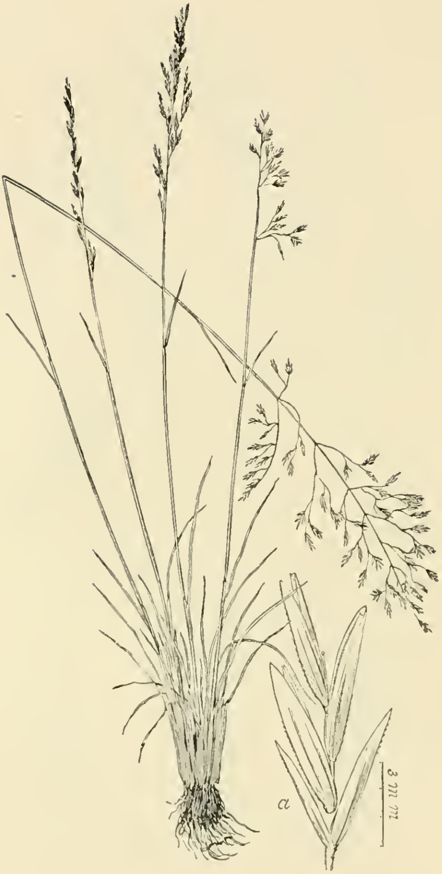

Fig. 551. **Poa gracillima** Vasey, Contrib. Nat. Herb. **1** : 272. 1893. Slender Spear-grass.—A smooth, densely tufted, erect perennial, with soft, narrow, flat leaves and open panicles 8 to 10 cm. long. Spikelets (*a*) 3-to 5-flowered, 6 to 8 mm. long, with rather distant florets, acute empty glumes and obtuse flowering glumes, which are 3 to 4 mm. long and scabrous or pubescent on the keel and nerves below.—Dry, rocky soil on ridges and mountain sides, central and northern California to Washington and British Columbia. May–August.

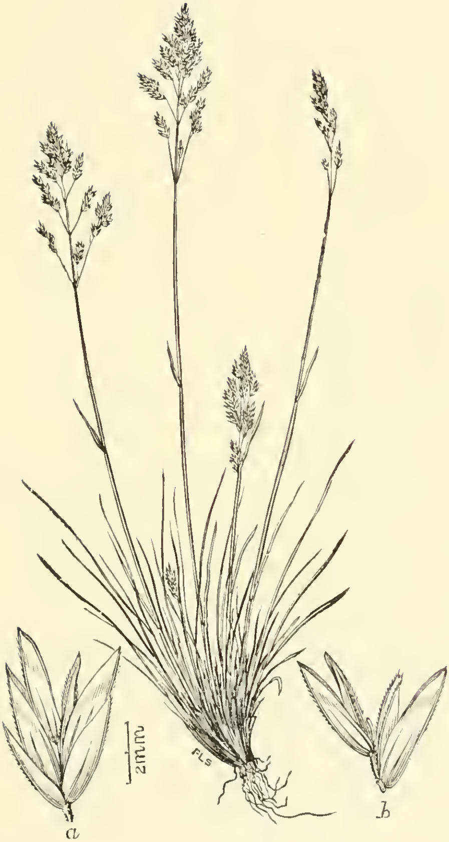

FIG. 555. **Poa cusickii** Vasey, Contrib. U. S. Nat. Herb. **1** : 271. 1893. CUSICK'S BLUE-GRASS.—A densely cæspitose, glabrous perennial, 3 to 4 dm. high, with very narrow leaves and contracted panicles 6 to 10 cm. long. Spikelets (*a*) 3-to 5-flowered, 8 to 10 mm. long, with acute empty glumes and lanceolate, acute flowering glumes which are 5 to 6 mm. long and finely scabrous on the back, at least below.—In canyons, Oregon and Idaho. May, June.

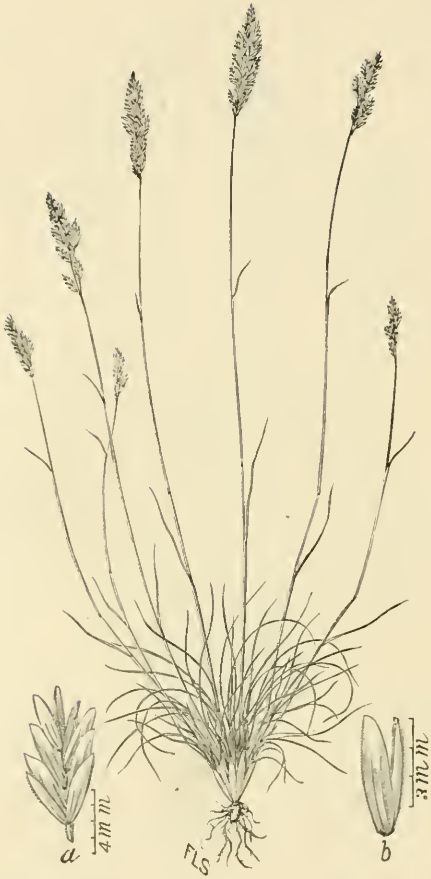

FIG. 556. **Poa nudata** Scribn., Cir. U. S. Dept. Agr., Div. Agros. **9**: 1. Feb. 24, 1899. (*Poa capillaris* Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: 51, fig. 11. July 20, 1898, not Linn.) FINE-LEAFED BLUE-GRASS.—A slender, erect, densely cæspitose perennial 3 to 4 dm. high, with capillary, flexuous basal leaves and long-exserted densely flowered panicles 3 to 5 cm. long. Spikelets 3- to 5-flowered, 7 to 10 mm. long, with broadly lanceolate, acute empty glumes; flowering glumes 4 to 5 mm. long, scabrous on the back, with short, appressed hairs near the base.—California.

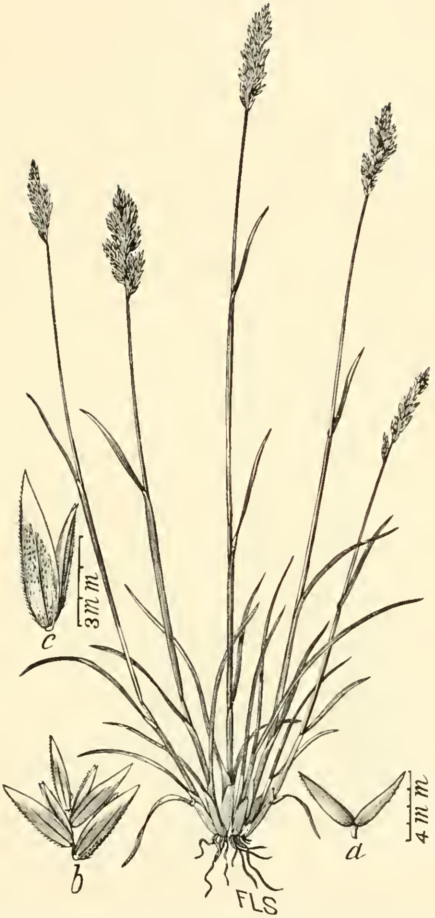

Fig. 557. **Poa purpurascens** Vasey, Coult. Bot. Gaz. **6** : 297. 1881. Purple-top Blue-grass.—A tufted, erect, somewhat wiry perennial, 2.5 to 3.5 dm. high, with flat leaves and rather densely flowered panicles 4 to 6 cm. long. Spikelets ovate, 3- to 5-flowered, 5 to 7 mm. long. Floral glumes obtuse, minutely scabrous on the back and hispid-ciliate on the keel.—Moist hillsides and meadows, California northward to British Columbia. July, August.

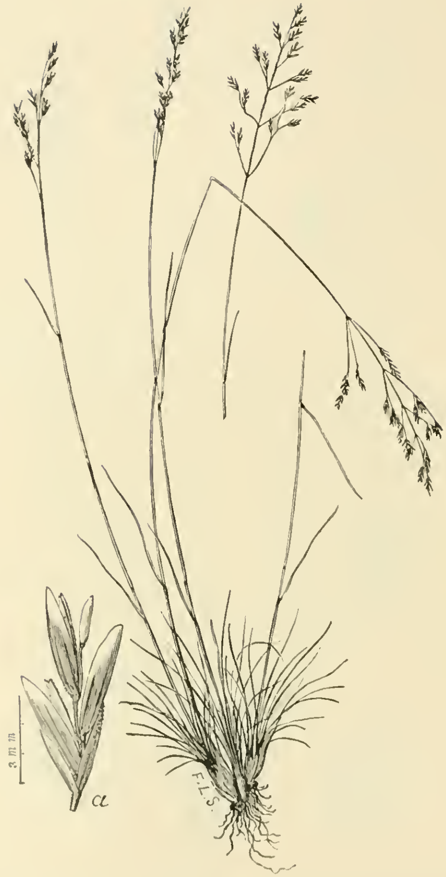

FIG. 558. **Poa tenerrima** Scribn. U. S. Dept. Agr., Div. Agros., Cir. 9:4. 1899. SLENDER-FLOWERED BLUE-GRASS.—A very slender, erect, caespitose perennial, 3 to 5 dm. high, with short, filiform leaves and spreading, capillary panicles 7 to 9 cm. long. Spikelets 3- to 4-flowered, about 7 mm. long with acute empty glumes and obtuse flowering glumes, which are smooth excepting for a short, crisp pubescence near the base, and are about 4 mm. long.—California.

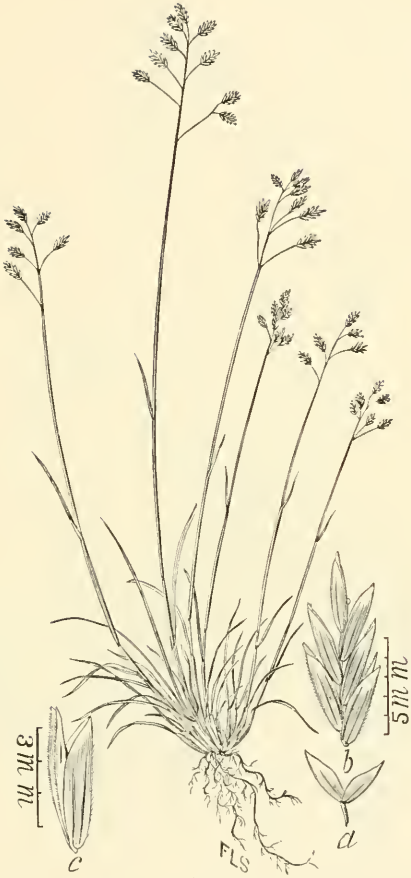

FIG. 559. **Poa vaseyochloa** Scribn. U. S. Dept. Agr., Div. Agros., Cir. **9**:1. 1899. (*P. pulchella* Vasey.) VASEY'S BLUEGRASS.—A slender, cæspitose perennial with short, filiform leaves, smooth, erect culms 1 to 1.5 dm. high, and delicate, open panicles 2 to 3 cm. long. Spikelets 3- to 5-flowered, 6 to 8 mm. long, with short, and usually obtuse outer glumes (*a*), and scabrous, obtuse, flowering glumes (*c*).—Moist places among rocks, Idaho, Washington, and Oregon. April, May.

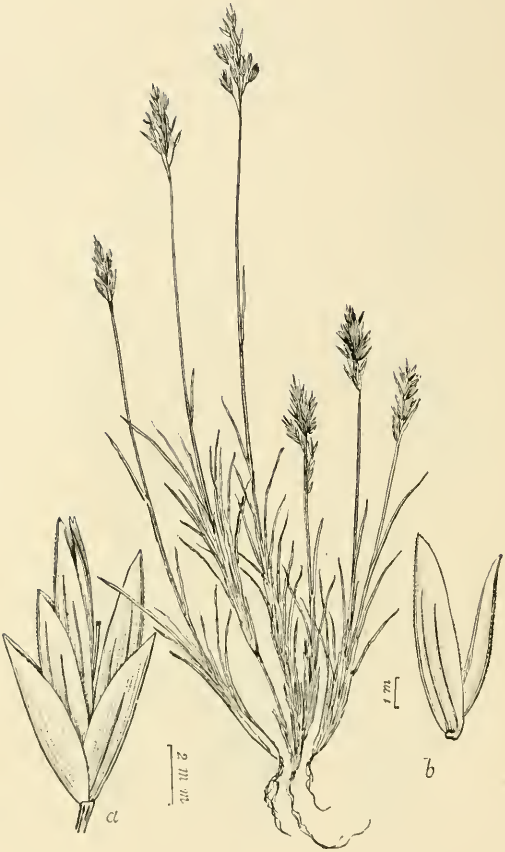

FIG. 560. **Poa argentea** Howell, Bull. Torr. Bot. Club **15** : 11. 1888; Vasey, Ill., N. Am. Grasses, **2** : No. 72. SILVERY BLUE-GRASS.—A slender, smooth, densely cæspitose, erect perennial 1.5 to 2.5 dm. high, with flat leaves and narrow, oblong, rather loosely flowered panicles 2 to 4 cm. long. Spikelets (*a*) oblong-lanceolate, 2- to 3-flowered, 6 to 7 mm. long, with thin, oblong, obtuse glumes, the floral ones (*b*) smooth, 4 to 5 mm. long.—In the mountains of western Oregon. July.

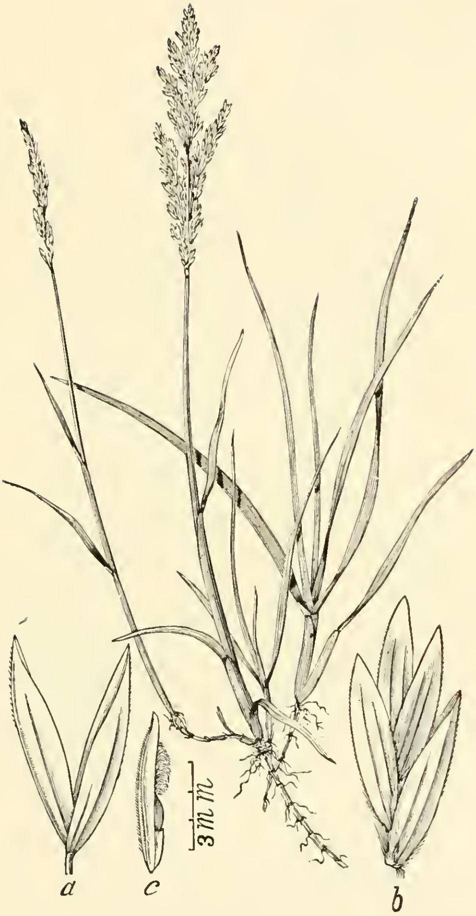

FIG. 561. **Poa glumaris** Trin. Mem. Acad. St. Petersb. (VI) 1:379. 1831. LARGE-FLOWERED BLUE-GRASS.—A stout, erect, smooth perennial 3 to 9 dm. high, from strong, creeping rootstocks, with thick, flat leaves, closely flowered, contracted panicles 8 to 16 cm. long. Spikelets 3- to 5-flowered, 8 to 12 mm. long; with nearly equal, acute, firm, empty glumes (*a*), and broadly-ovate flowering glumes which are 4 to 5 mm. long and pubescent on the margins and keel below, not webbed.—Nova Scotia, Quebec, and westward to Alaska. May–September.

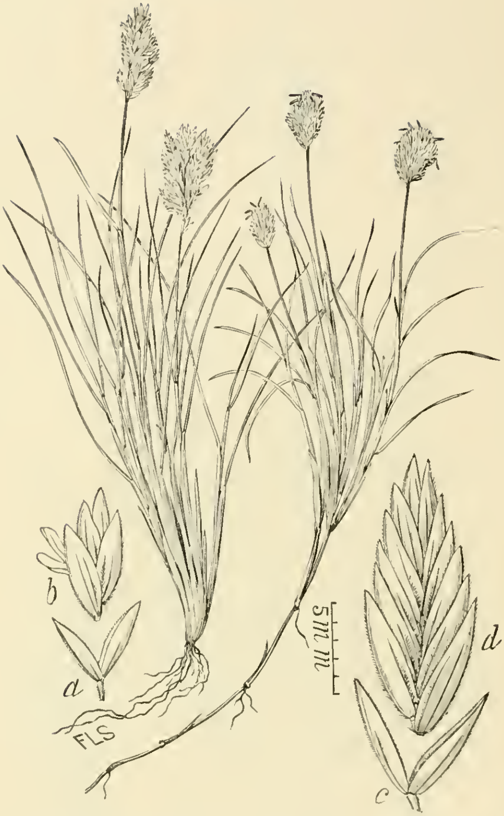

FIG. 562. **Poa douglassii** Nees, Ann. Nat. Hist. **1**: 284. 1838. Thurb. in Brewer and S. Wats. Bot. Calif. **2** : 314. (*Brizopyrum douglassii* Hook. & Arn.) DOUGLASS' SAND-GRASS.—A slender, tufted perennial, 1.5 to 3 dm. high, from long, creeping rootstocks, with numerous, convolute radical leaves, flat culm leaves, and densely flowered panicles 2 to 4 cm. long. Spikelets 3- to 5-flowered, about 8 mm. long, with acute empty glumes (*a c*) and acute flowering glumes which are 6 mm. long, ciliate-pubescent on the keel above, and softly hairy or more or less crisped-woolly below.—In sands along the coast, California and northward. May.

An excellent sand binder.

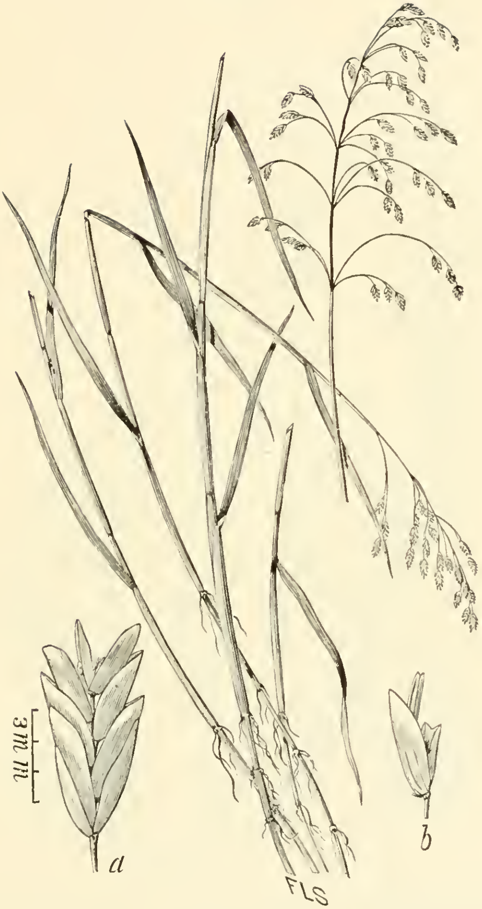

Fig. 563. **Colpodium pendulinum** (Laest.) Griseb. in Ledeb. Flor. Ross. **4** : 386. 1853. Nodding Colpodium.—A smooth, erect perennial 6 to 7 dm. high, with flat leaves and open, nodding panicles about 12 cm. long. Spikelets (*a*) oblong, 4- to 6-flowered, 4 to 6 mm. long, with smooth, nearly equal empty glumes and broadly ovate-oblong flowering glumes which are 3 to 3.5 mm. long, with a few short hairs at the base.—Moist banks, British America and Alaska. [Northern Europe.] July, August.

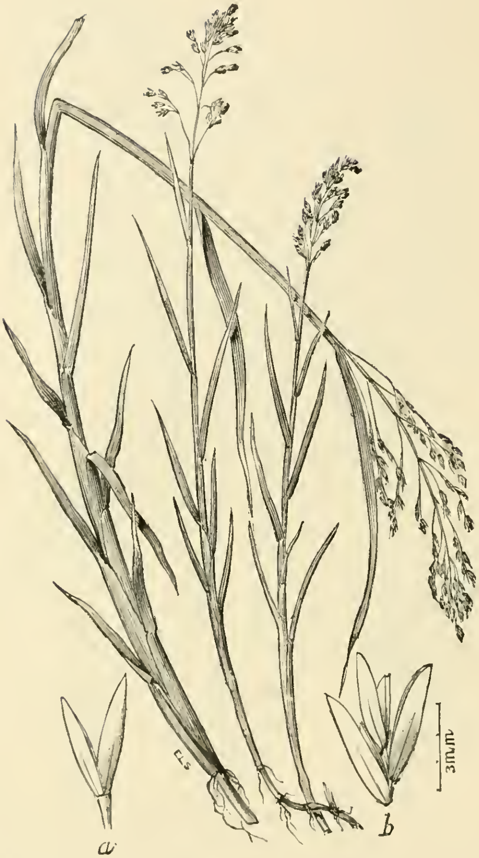

FIG. 564. **Colpodium fulvum** (Trin.) Griseb. in Ledeb. Flor. Ross., **4**: 385. 1853. (*Poa fulva* Trin. Mem. Acad. St. Petersb. Ser. 1, **6**: 378. 1845. *Graphephorum fulvum* A. Gray). YELLOW COLPODIUM.—A rather stout, erect, leafy, and glabrous perennial, 2 to 6 dm. high, with flat, sharp-pointed leaves and open panicles 8 to 15 cm. long. Spikelets 4- to 6-flowered, 5 to 6 mm. long, with broadly lanceolate empty glumes (*a*) and obtuse flowering glumes about 4 mm. long.—Moist situations, British Columbia to Alaska. [Greenland and Northern Europe.] August.

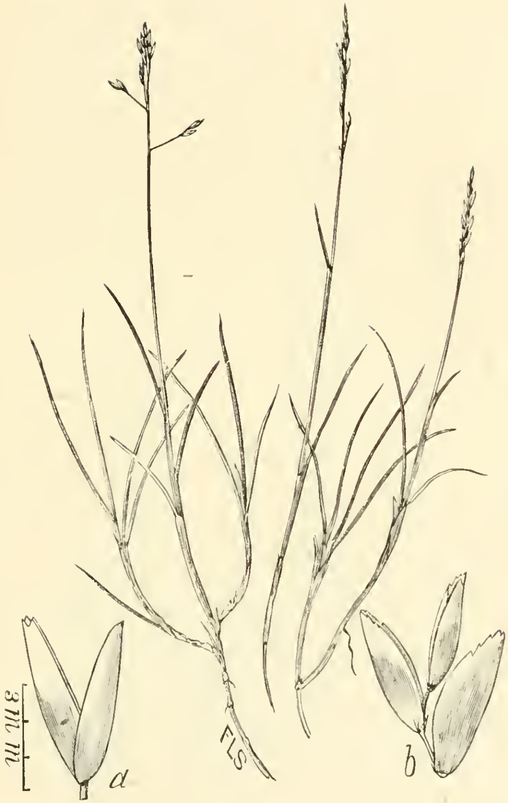

FIG. 565. **Dupontia psilosantha** Rupr. Flor. Samaj. Cisural. 65, t. 6. 1845. (*Graphephorum fisheri psilosanthum* A. Gray.) SLENDER DUPONTIA.—A slender, erect, glabrous perennial 2 to 4 dm. high, from a creeping rootstock, with flat, attenuate-pointed leaves and contracted or, in anthesis, spreading panicles 7 to 12 cm. long. Spikelets 2- to 3-flowered, 6 to 7 mm. long, with broad and usually obtuse empty glumes (*a*) and obovate, obtuse, glabrous flowering glumes.—Newfoundland, Hudsons Bay to Alaska. [Arctic-Siberia.] August, September.

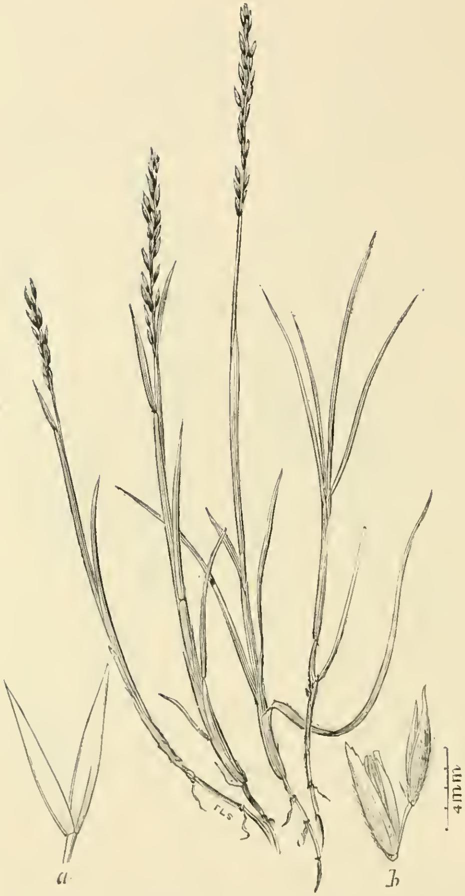

FIG. 566. **Dupontia fischeri** R. Br. in Parry's Voy. App. 291. 1824. FISHER'S DUPONTIA.—A slender, erect perennial 1 to 2.5 dm. high, from a creeping rootstock, with flat, attenuate-pointed leaves and contracted, simple panicles 4 to 7 cm. long. Spikelets 2- to 3-flowered, 6 to 7.5 mm. long, with lanceolate, acute empty glumes (*a*), and obtuse or acute flowering glumes which are silky-pilose on the back toward the base.—Moist situations, Arctic America. [Siberia.] June-August.

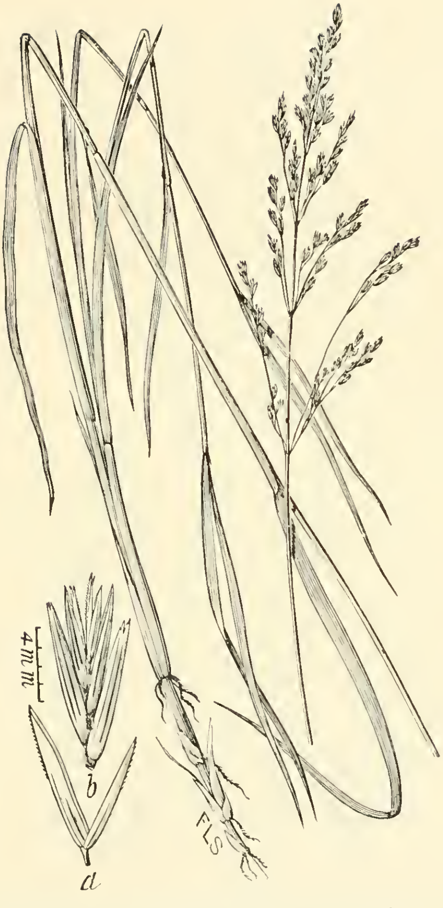

FIG. 567. **Scolochloa festucacea** (Willd.) Link. (*Arundo festucacea* Willd. Enum. **1**: 126. 1809.) SPRANGLE-TOP.—A stout, erect, glabrous perennial 9 to 15 dm. high, with long, flat leaves and open panicles 16 to 30 cm. long. Spikelets 3- to 5-flowered, 6 to 8 mm. long, with unequal, acute, outer glumes (*a*) and 7-nerved, scabrous flowering glumes which have a tuft of hairs at the base.—Wet grounds or in shallow water, Minnesota, Iowa to Nebraska, and northward. [Northern Europe.] June–August.

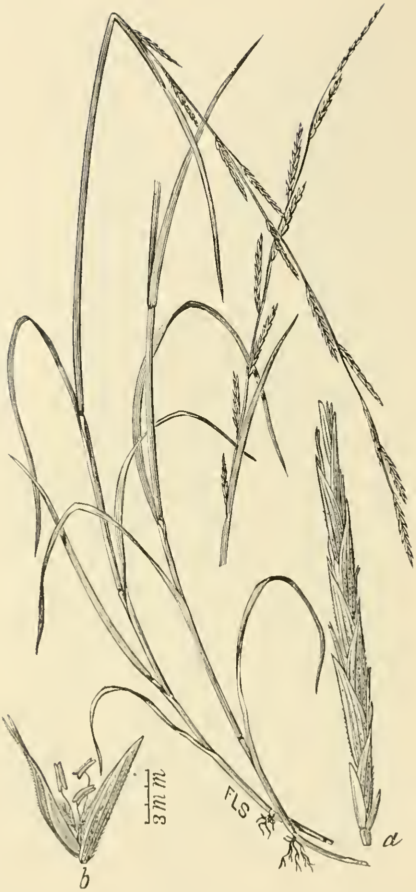

FIG. 568. **Panicularia acutiflora** (Torr.) Kuntze. (*Glyceria acutiflora* Torr. Fl. U. S. 1: 104. 1824.) ACUTE-FLOWERED MANNA-GRASS.—A rather slender, glabrous perennial 3 to 6 dm. high, with flat leaves and narrow, simple panicles 15 to 30 cm. long. Spikelets (*a*) narrow, 24 to 42 mm. long, 5- to 12-flowered; empty glumes unequal, acute; flowering glumes scabrous, acute, about 8 mm. long, exceeded by the long-acuminate paleas.—Wet soil and in shallow water, Maine to Ohio, and southward to New Jersey and Tennessee. May, June.

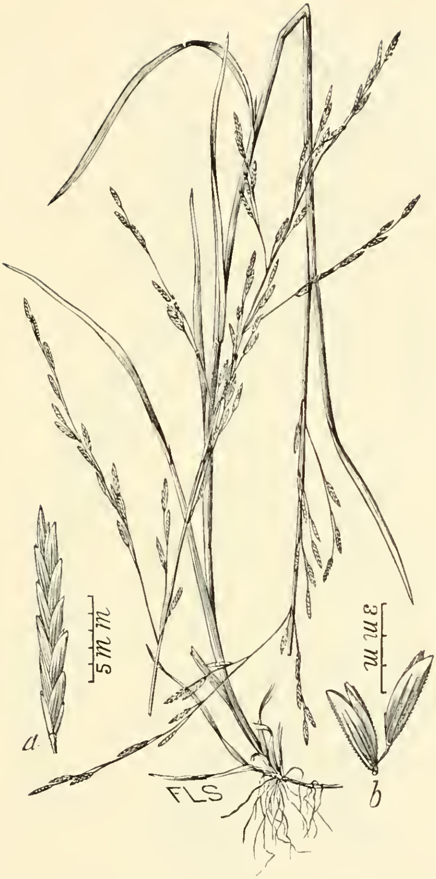

FIG. 569. **Panicularia borealis** Nash, Bull. Torr. Bot. Club, **24**: 348. 1897. NORTHERN MANNA-GRASS.—A rather slender, smooth perennial 4 to 15 dm. high, with flat leaves and narrow panicles 12 to 40 cm. long. Spikelets (*a*) 10 to 18 mm. long, 7- to 13-flowered with thin, unequal empty glumes, and obtuse flowering glumes which are hispidulous along the nerves and 4 to 5 mm. long.—Margins of streams and ponds, New England and New York westward to Washington and California. June–September.

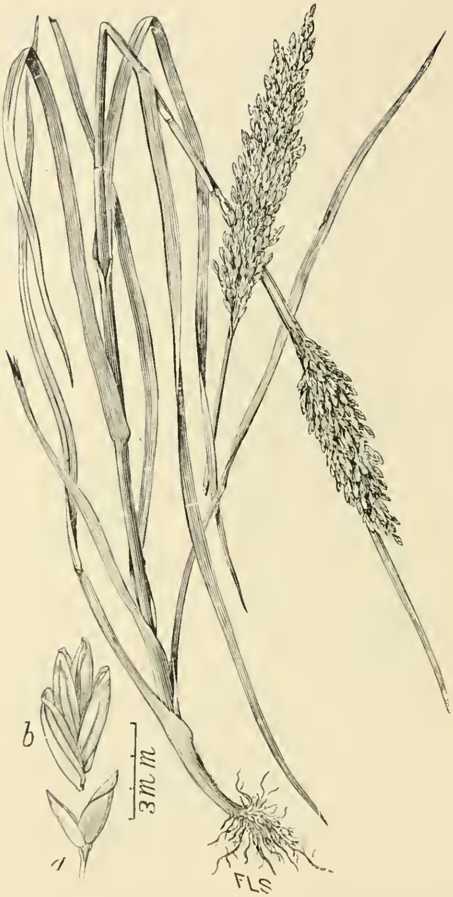

FIG. 570. **Panicularia obtusa** (Muhl.) Kuntze (*Poa obtusa* Muhl. Gram. 147. 1817.) DENSELY FLOWERED MANNA-GRASS.—A stout, erect, glabrous grass 3 to 9 dm. high, with rather broad, flat leaves, and contracted, many-flowered panicles 6 to 18 cm. long. Spikelets 3- to 7-flowered, 4 to 6 mm. long, with broad, obtuse flowering glumes (*b*) about 3 mm. long.—Wet, swampy places, New Brunswick to New York and Pennsylvania, south to Virginia and North Carolina. July–October.

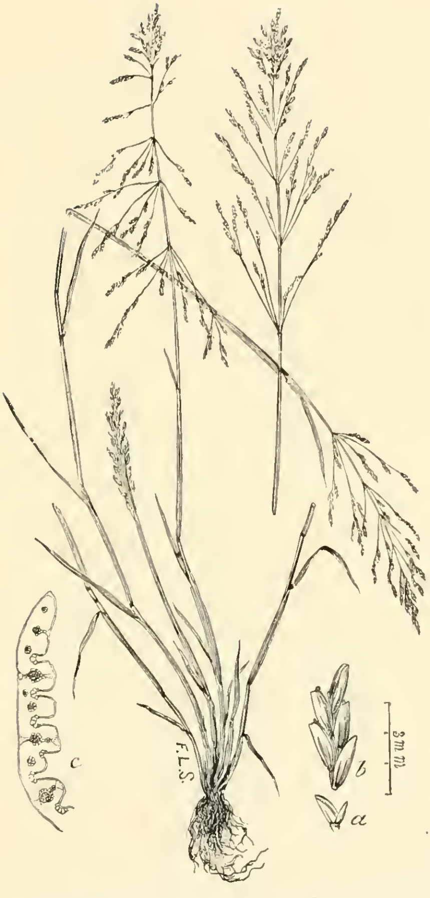

Fig. 571. **Puccinellia distans** (Linn.) Parl. Flor. Ital. **1**: 367. 1848. (*Poa distans* Linn.) Spreading Spear-grass.—A slender, erect, or sometimes decumbent, tufted, glabrous perennial 3 to 6 dm. high, with flat leaves and diffusely spreading panicles, 5 to 18 cm. long, branches often becoming finally deflexed. Spikelets 3- to 6-flowered, 3 to 5 mm. long.—Saline soils, Nova Scotia to New Jersey and Pennsylvania and on the west coast from California to Alaska. [Europe, Asia.] June–August.

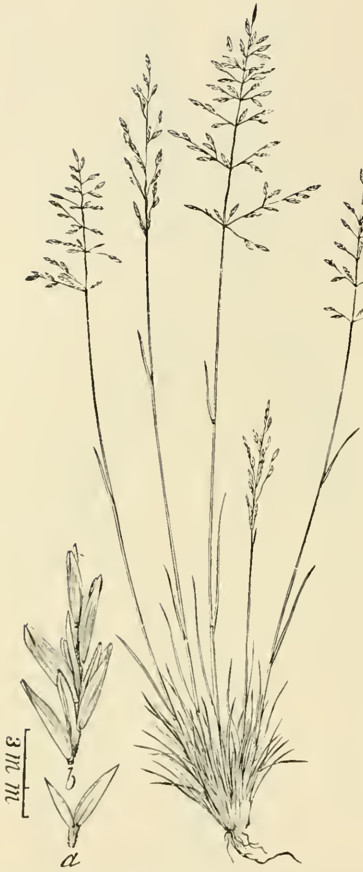

FIG. 572. **Puccinellia lemmoni** (Vasey). Scribn. n. comb. (*Poa lemmoni* Vasey, Coulter Bot. Gaz. **3**: 1878.) LEMMON'S SPEAR-GRASS.—A tufted, pale green or glaucous perennial, with slender, smooth and somewhat wiry, upright culms 3 to 4.5 dm. high, with numerous, short basal leaves and spreading panicles 6 to 10 cm. long. Spikelets very narrow, 3- to 7-flowered, 4 to 6 mm. long.—Alkali flats, Nevada and California to Vancouver Island, Alberta, and Assiniboia. June, July.

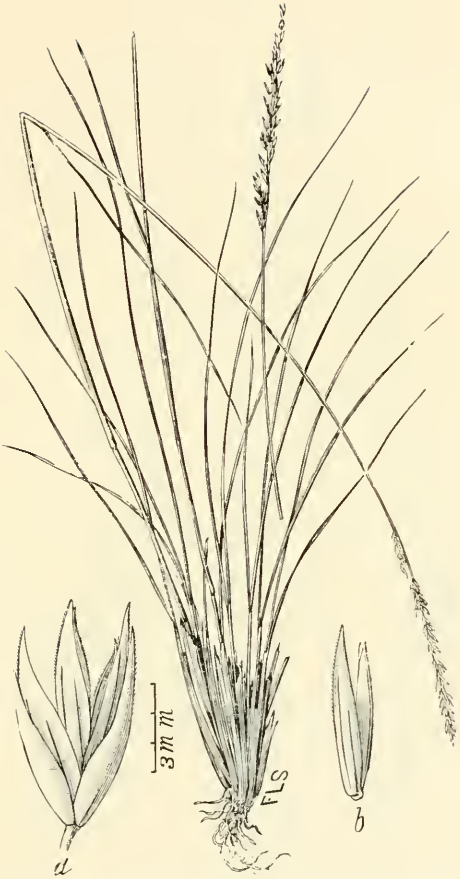

FIG. 573. **Festuca kingii** (S. Wats.) Scribn. U. S. Dept. Agr., Div. Agros. **5** : 36. 1897. (*Festuca confinis* Vasey; *Poa Kingii* S. Wats. Bot. King's Exp. 387. 1871.) KING'S FESCUE.—A stout, erect, strongly cæspitose perennial 6 to 9 dm. high, with rigid culms, long, narrow leaves, and contracted panicles 8 to 10 cm. long. Spikelets (*a*) 3- to 5-flowered, 6 to 8 mm. long, with ovate-lanceolate, acute outer glumes, and scabrous, rather rigid flowering glumes about 6 mm. long.—Dry mountain sides, Montana to Oregon and south to Colorado and Nevada. May–August.

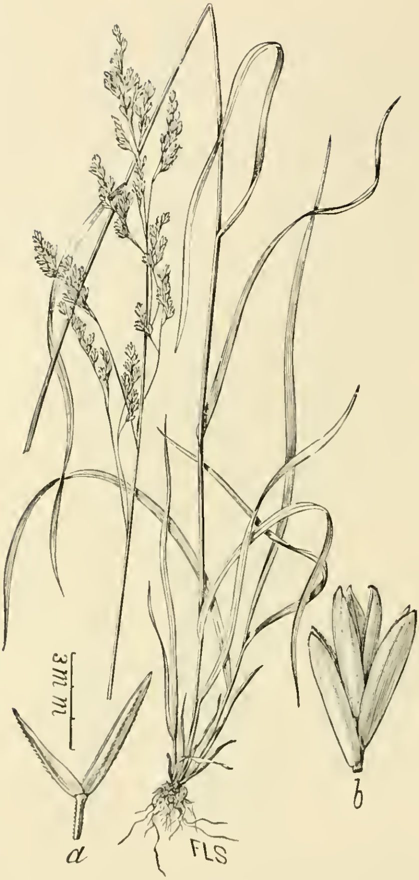

FIG. 574. **Festuca obtusa** Spreng. Mant. Fl. Hal. 34. 1807. (*F. shortii* Kunth, Wood's Class Book of Botany, 794. 1861.) SHORT'S FESCUE.—A rather stout, erect, glabrous perennial 6 to 12 dm. high, with flat leaves and rather narrow, nodding panicles 8 to 16 cm. long. Spikelets broadly obovate, 3- to 6-flowered, 5 to 6 mm. long, with the flowering glumes about 4 mm. long.—Open woods and thickets, Pennsylvania to Illinois, Tennessee, Kansas, Mississippi, and Texas. July, August.

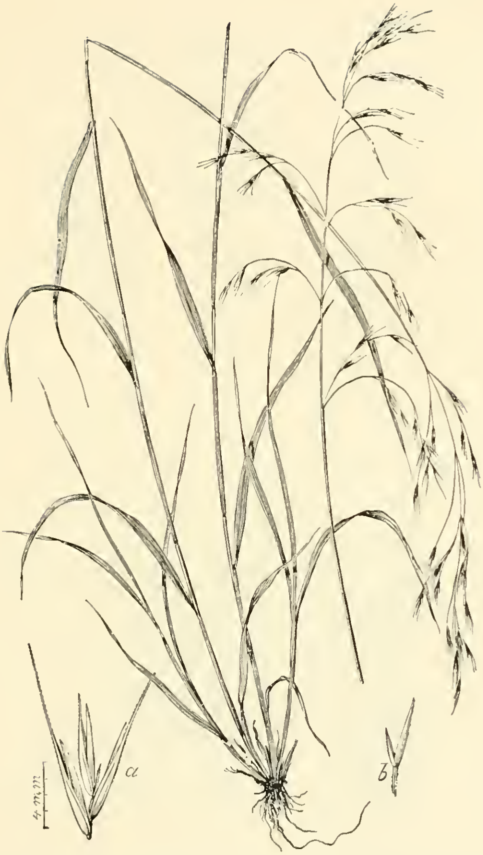

FIG. 575. **Festuca jonesii** Vasey, Contrib. Nat. Herb. **1**: 278. 1893. JONES'S FESCUE.—An erect, usually slender, cæspitose, leafy perennial 6 to 12 dm. high, with flat leaves 10 to 24 cm. long and open, nodding panicles 15 to 30 cm. long. Spikelets about 12 mm. long, including the awns, 3- to 5-flowered, with unequal, acute empty glumes (*b*) and narrow flowering glumes about 5 mm. long.—Moist places near springs and borders of woodlands in the mountains, Wyoming, Utah, California to Vancouver Island, and Alaska. June–August.

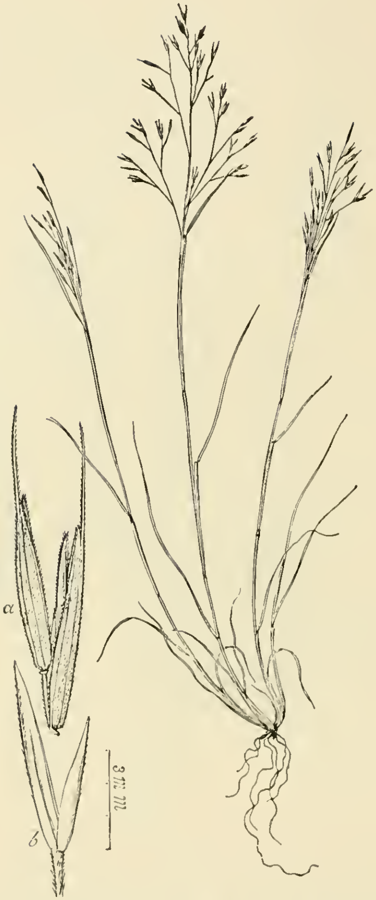

FIG. 576. **Festuca dasyclada** Hackl. in Beal, Grasses N. Am. **2**: 602. 1896. HACKEL'S FESCUE.—A slender perennial 2 to 4 dm. high, the culms often geniculate below, with smooth sheaths, narrow leaves, and ovoid-pyramidal panicles 7 to 12 cm. long. Spikelets usually 2-flowered, about 7 mm. long, with acute empty glumes (*b*) and scabrous, short-awned flowering glumes (*a*) about 6 mm. long.—Southern California and (?) Utah.

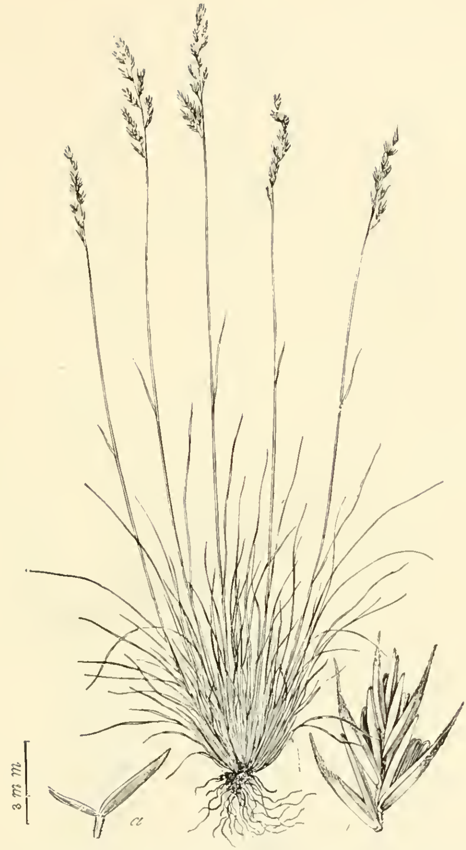

FIG. 577. **Festuca ovina** Linn. Sp. Pl. 73. 1753. SHEEP'S FESCUE.—A slender, densely tufted, erect perennial 2 to 6 dm. high, with narrow or filiform, involute leaves and contracted (expanding while in bloom) panicles 3 to 6 cm. long. Spikelets 3- to 5-flowered, with unequal empty glumes (*a*), and usually short-awned, smooth flowering glumes 3 to 4 mm. long.–New England to Pennsylvania, and westward to the Pacific; especially abundant in many varieties in the Rocky Mountain region. June–September.

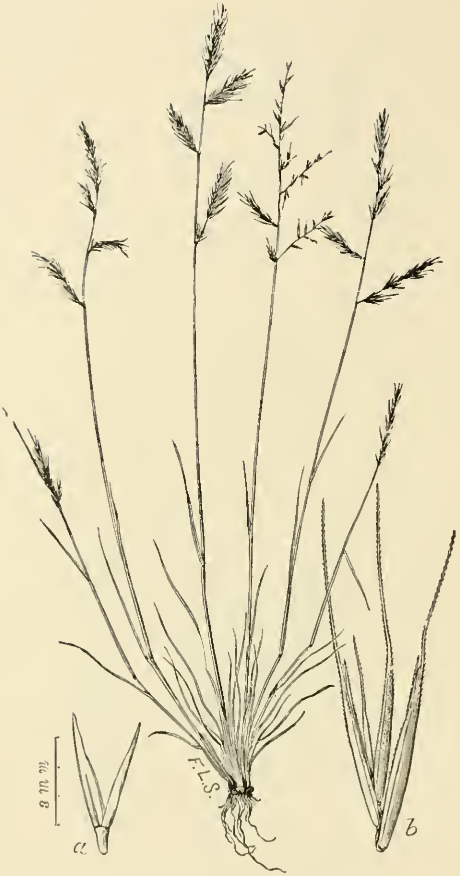

Fig. 578. **Festuca microstachys** Nutt. Journ. Acad. (n. ser.) **1**: 187. 1848; Vasey Ill. N. Am. Grasses, **2**: 91.) Small-topped Fescue.—A slender, cæspitose annual 1 to 4 dm. high, with narrow, filiform leaves and simple, racemose or spike-like panicles 2 to 10 cm. long. Spikelets 1- to 5-flowered with nearly equal empty glumes and awned flowering glumes 4 to 6 mm. long; awn 6 to 10 mm. long.—Utah, Nevada, and Idaho to Vancouver Island, southward to Arizona and southern California. April–June.

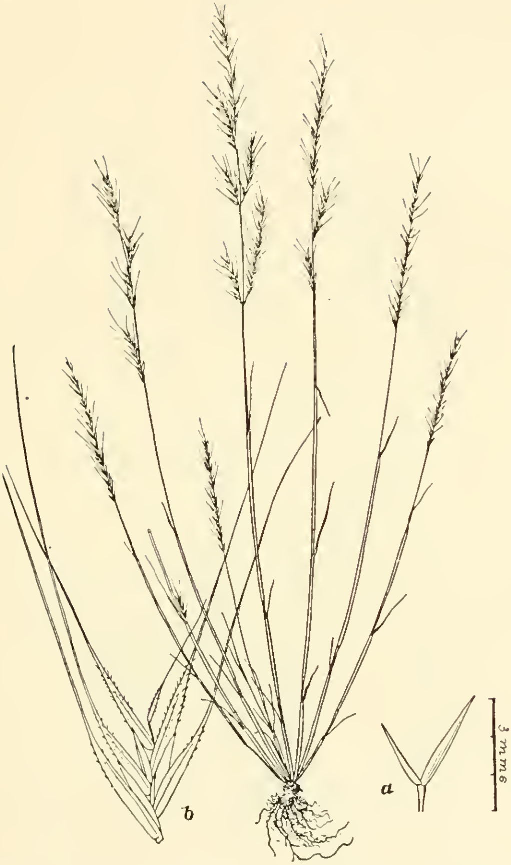

FIG. 579. **Festuca sciurea** Nutt. Trans. Amer. Phil. Soc. 5: 147. 1837.—A slender, erect, cæspitose annual 1.5 to 5 dm. high, with short, filiform leaves and narrow, simple panicles 5 to 20 cm. long. Spikelets 4 to 6 mm. long, 3- to 7-flowered, with unequal empty glumes (*a*), the second 3-nerved, and very narrow flowering glumes which are pilose, especially above, and terminate in slender awns 8 to 12 mm. long.—Arkansas, Indian Territory, Mississippi, and Texas.

Distinguished from *F. octoflora* by its pilose flowering glumes and longer awns.

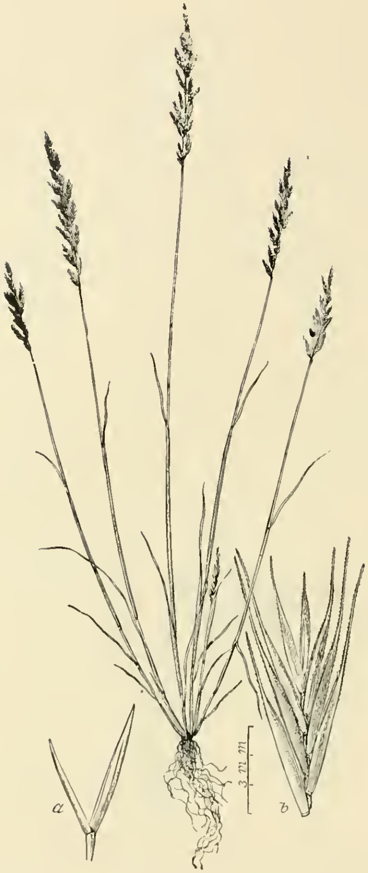

FIG. 580. **Festuca octoflora** Walt. Flor. Carol. 81. 1788. (*Festuca tenella* Willd. Enum. **1**: 113. 1809.) SLENDER FESCUE.—A slender, erect, more or less cæspitose annual 1 to 5 dm. high, with narrow, simple panicles 2 to 15 cm. long. Spikelets 5- to 13-flowered, 6 to 10 mm. long, with slightly unequal, acute empty glumes (*a*) and narrow, usually scabrous, short-awned or nearly awnless flowering glumes 3 to 5 mm. long.—Dry, sandy, gravelly, or rocky soil from Canada to Florida, and westward to Washington and California. May–August.

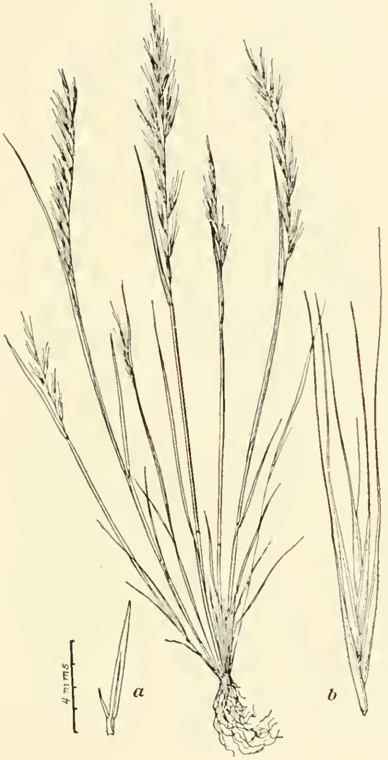

Fig. 581. **Festuca myuros** Linn. Sp. Pl. 74. 1753. Rat's-tail Fescue.—A smooth, slender, erect annual 3 to 6 dm. high, with narrow, involute leaves and contracted, usually one-sided panicles 8 to 24 cm. long. Spikelets 3- to 6-flowered, with very unequal, acute empty glumes (*a*), and narrow, scabrous, slender-awned flowering glumes 4 to 6 mm. long. Awns much longer than the glumes.—Fields and waste places, Massachusetts to Florida, and westward to California and Washington. [Europe.] April–July.

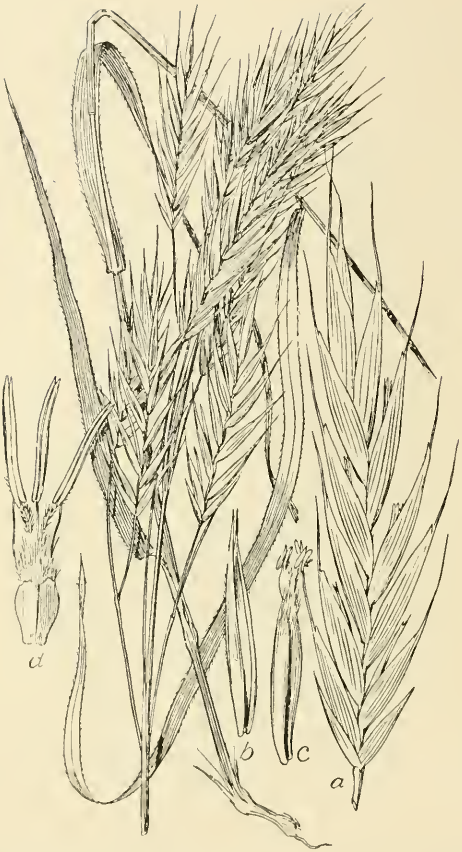

FIG. 582. **Bromus hookerianus** Thurb. in Bot. Wilkes Expl. Exped. **2**: 493. 1874. (*Ceratochloa grandiflora* Hook. Flor. Bor. Am. **2**: 253. 1840.) GREAT WESTERN BROME.—A stout, erect perennial 3 to 12 dm. high, with pubescent or hirsute sheaths and leaves and nearly simple, lax panicles 20 to 35 cm. long. Spikelets 35 to 50 mm. long, 9- to 13-flowered, strongly compressed, scabrid-pubescent, with sharply acuminate-pointed empty glumes and 9-nerved, short-awned flowering glumes; these more remote, less compressed, and much longer awned than in *B. breviaristatus.*—California to Washington, and eastward to Montana.

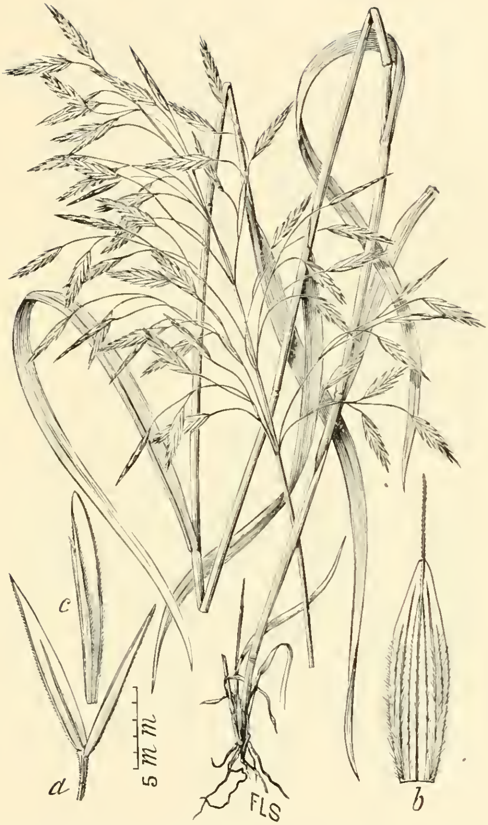

FIG. 583. **Bromus ciliatus** Linn. Sp. Pl. 77. 1753. SWAMP CHESS.—A stout, erect, leafy perennial, 6 to 12 dm. high, with flat leaves and open, nodding panicles 10 to 25 cm. long. Spikelets 5- to 8-flowered, 10 to 20 mm. long, with acute outer glumes, the first 1-nerved, the second 3-nerved, and short-awned flowering glumes, which are ciliate-pubescent near the margins and 8 to 10 mm. long.—Open woodlands and borders of thicket, Canada, British Columbia, and southward to Florida and Texas. June–September.

A widely distributed native grass of little agricultural value.

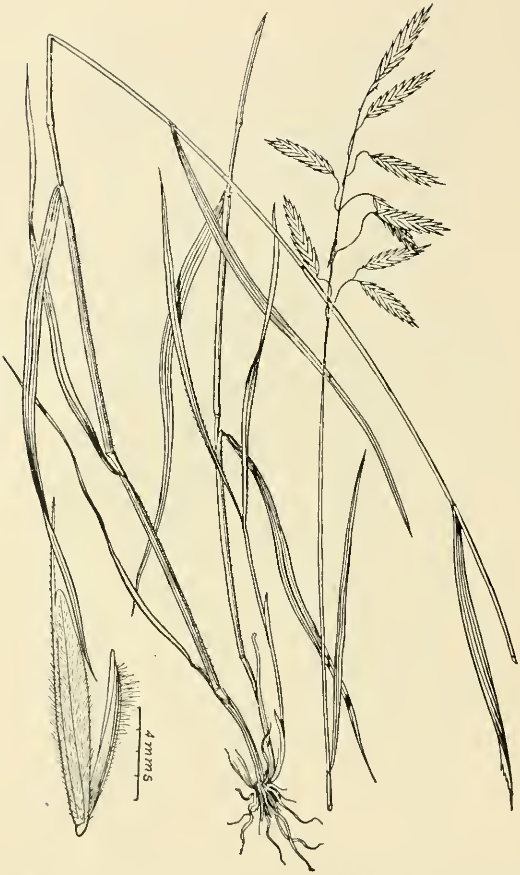

FIG. 581. **Bromus kalmii A. Gray**, Man. 600. 1848. KALM'S BROME-GRASS.—A rather slender, erect perennial, 4.5 to 9 dm. high, with usually pubescent sheaths and leaves, and nodding, few-flowered panicles 5 to 15 cm. long. Spikelets 6- to 10-flowered, 12 to 24 mm. long, on slender, flexuous pedicels; the first glume 3-nerved, the second 5- to 7-nerved; the flowering glume about 8 mm. long, densely silky-pubescent, and short-awned.—Dry soil, Canada to Pennsylvania, and westward to Utah, Idaho and British Columbia. June–August.

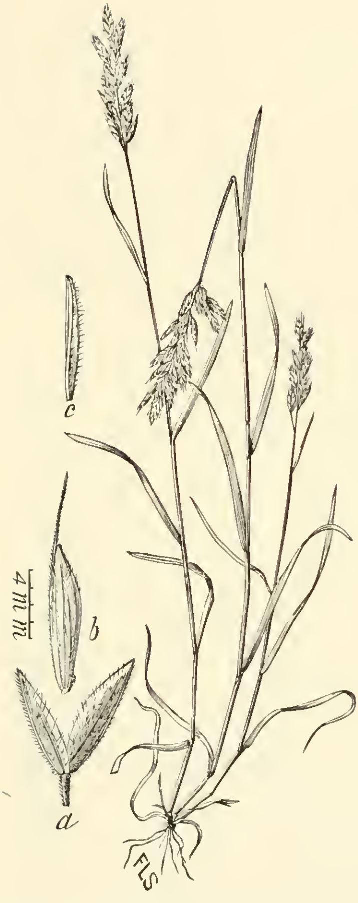

Fig. 585. **Bromus hordeaceus** Linn. Sp. Pl. 77. 1753. (*B. mollis* Linn. Sp. Pl. Ed. 2, 112. 1762.) Soft Chess.—An erect, usually slender, pubescent annual, 2 to 6 dm. high, with flat leaves and contracted panicles 2 to 6 cm. long. Spikelets 3-to 8-flowered, 1.5 to 2 cm. long, with pubescent glumes, the flowering ones 7 to 9 mm. long, obtuse and awned. Awns 6 to 8 mm. long.—In fields and waste places throughout. [Adventive from Europe.] May–August.

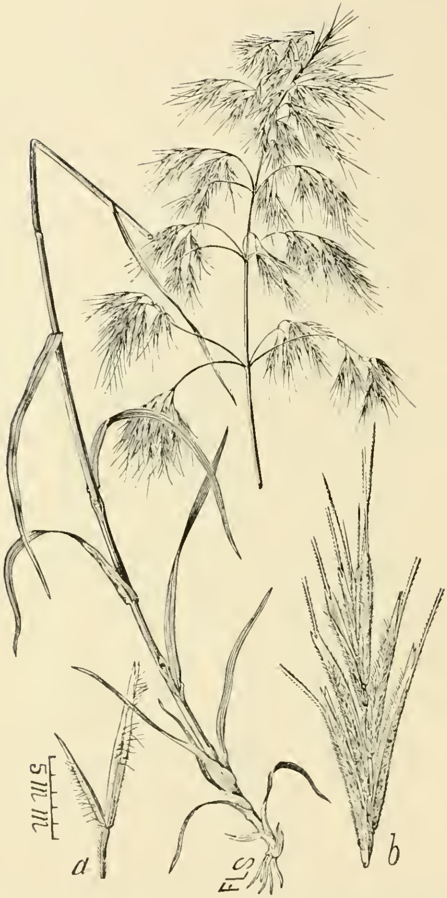

Fig. 586. **Bromus tectorum** Linn. Sp. Pl. 77. 1753. Downy Brome-grass.—A slender, erect, leafy annual, 1.5 to 6 dm. high, with narrow, softly pubescent leaves and open, nodding panicles 6 to 15 cm. long. Spikelets 5- to 8-flowered, with unequal, acuminate-pointed, hirsute empty glumes, and rough or hirsute flowering glumes 8 to 12 mm. long. Awns 12 to 16 mm. long.—Waste places, New England to Virginia and Ohio; also California to Washington. A weed, introduced from Europe.

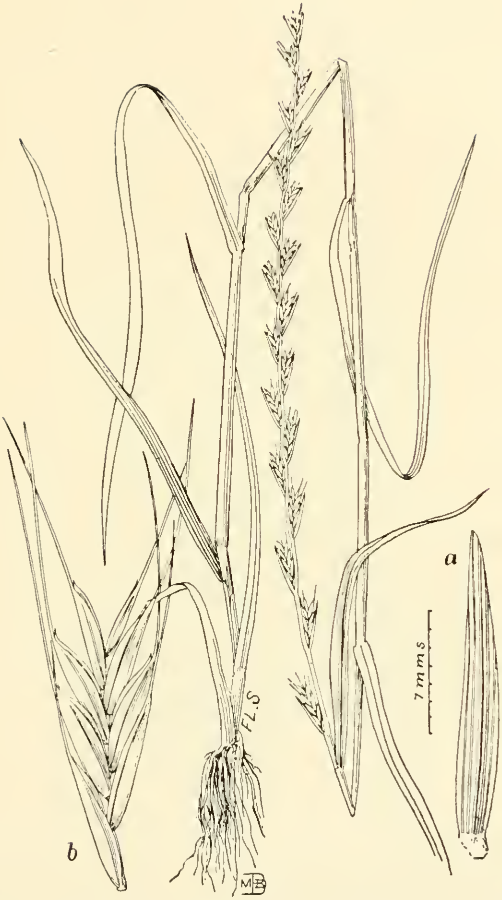

FIG. 587. **Lolium temulentum** Linn. Sp. Pl. 83. 1753. DARNEL.—A glabrous, erect, and usually rather stout annual, 6 to 12 dm. high, with flat leaves and erect spikes 10 to 30 cm. long. Spikelets 4- to 8-flowered, 10 to 18 mm. long, the empty glume (*a*) as long as or exceeding the spikelet.—Waste places and cultivated grounds. A weed, introduced from Europe. May–August.

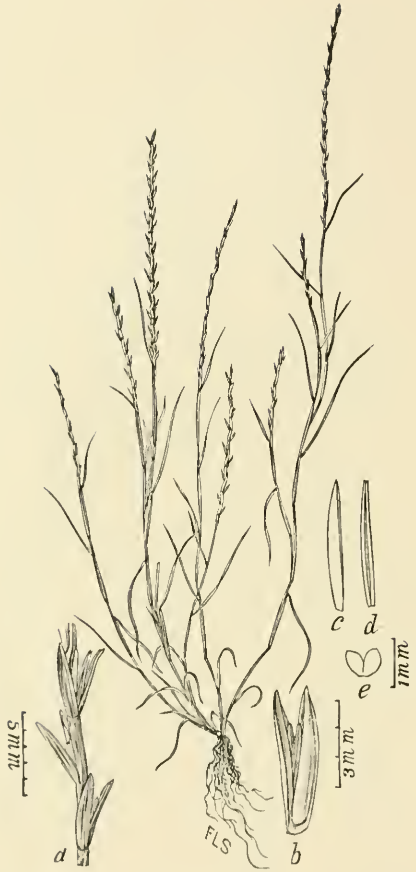

FIG. 588. **Lepturus filiformis** (Roth) Trin. Fund. Agros. 123. 1820. (*Rottboellia filiformis* Roth, Catal., **1**:21. 1797.) SLENDER HARD-GRASS.—A slender and rather rigid, much-branched annual, 1 to 3 dm. high, with narrow, flat leaves, and slender, erect, or curved spikes 2 to 12 cm. long. Spikelets 4 to 5 mm. long, with acute empty glumes and 1-nerved flowering glumes 3.5 mm. long.—Waste places, southern Pennsylvania to Virginia. Introduced from Europe. May–July.

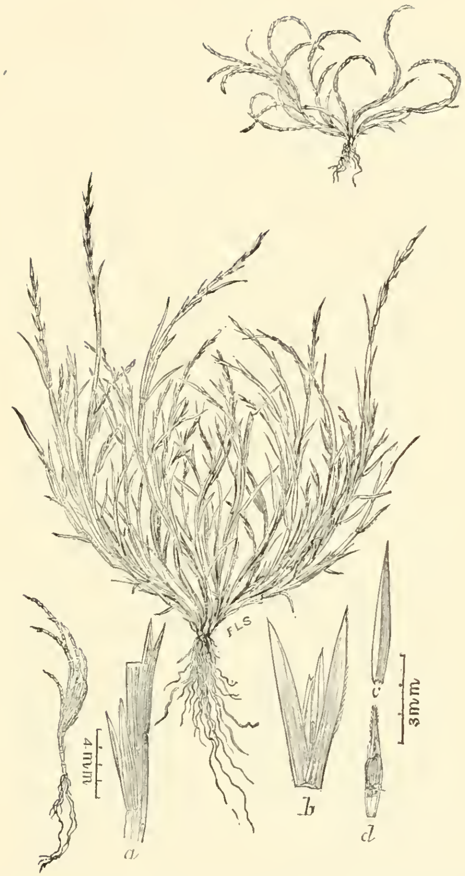

FIG. 589. **Lepturus incurvatus** (Linn.) Trin. Fund. Agros. 123. 1820. (*Aegilops incurvata* Linn. Sp. Pl. I: 1051. 1753; *Rottbœllia incurvata* Linn. Suppl. 114.) CURLY HARD-GRASS.—A low, much branched annual 1 to 2 dm. high, with narrow leaves and usually strongly incurved spikes 2 to 8 cm. long. Spikelets about 6 mm. long, the acute empty glumes much exceeding the hyaline floral glume.—Borders of brackish marshes, Maryland to southern Virginia, New Jersey (on ships' ballast) and California. Introduced from Europe.

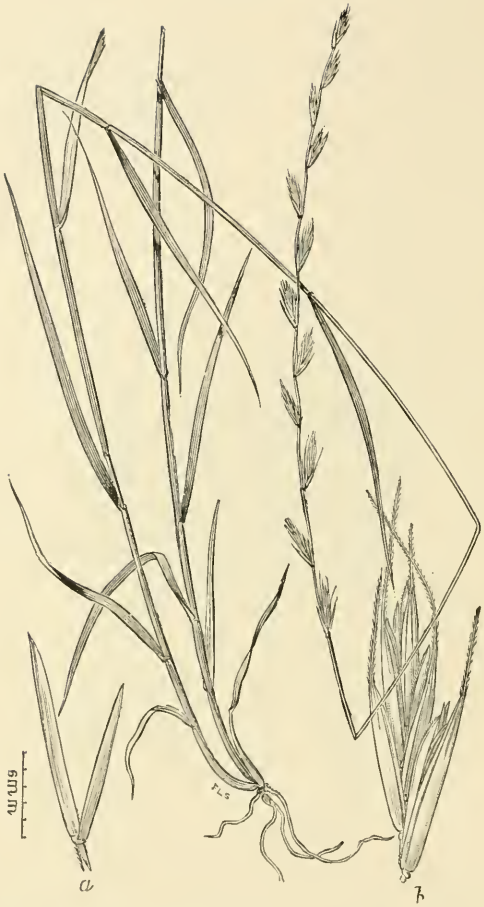

FIG. 590. **Agropyron parishii** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **4** : 28. 1897. PARISH'S WHEAT-GRASS.—A rather stout, erect, cæspitose perennial 6 to 10 dm. high, with flat leaves and erect or nodding spikes, 15 to 30 cm. long. Spikelets remote, 5- to 7-flowered, 16 to 20 mm. long. Empty glumes (*a*) two-thirds as long as the spikelets. Flowering glumes lanceolate, 9 to 11 mm. long, short-awned.—San Bernardino Mountains, California. May, June.

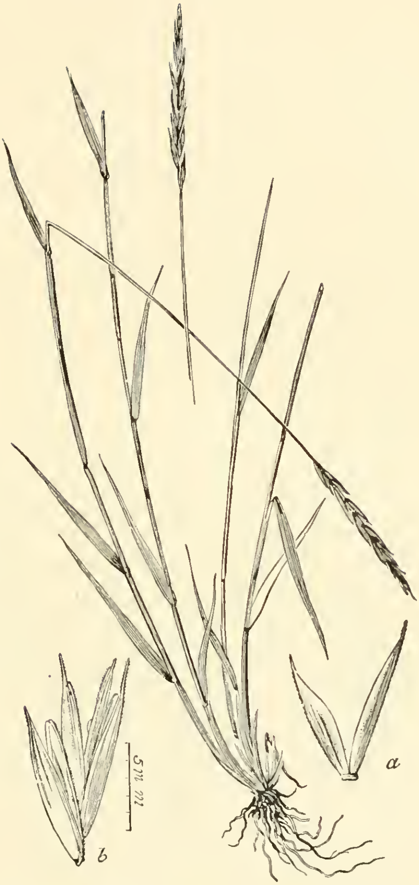

FIG. 591. **Agropyron violaceum** (Hornm.) Vasey. (*Triticum violaceum* Hornm. Fl. Dan. t. 2044. 1832.) 1883. NORTHERN WHEAT-GRASS.—An erect, cæspitose perennial, with rather short, flat leaves and comparatively stout spikes 2 to 6 cm. long. Spikelets 3- to 4-flowered, with short-awned or awnless glumes, which are broadest above the middle.—Labrador and southward in the mountains of New England, New York, and Pennsylvania, westward to Colorado and Utah, and northward to Alaska. June–September.

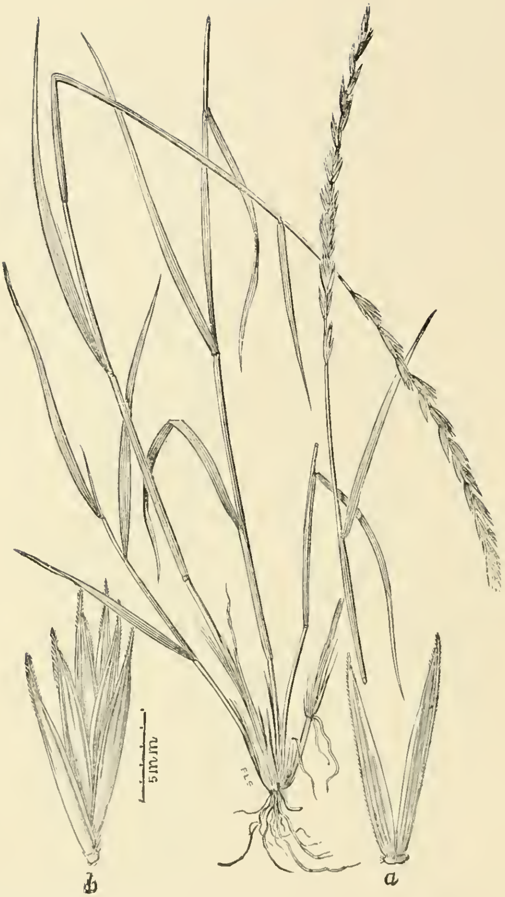

FIG. 592. **Agropyron pseudorepens** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. 4:34. 1897. FALSE COUCH-GRASS.—An erect, rather stout perennial 3 to 9 dm. high, from creeping rootstocks, with flat, scabrous leaves, and erect spikes 8 to 16 cm. long. Spikelets 10 to 16 mm. long, 3- to 7-flowered, with linear-lanceolate, nearly equal and 5-nerved empty glumes, and acuminate or awn-pointed flowering glumes.—Rather moist soil, Texas and Arizona to Nebraska, Montana, and British America. May–September.

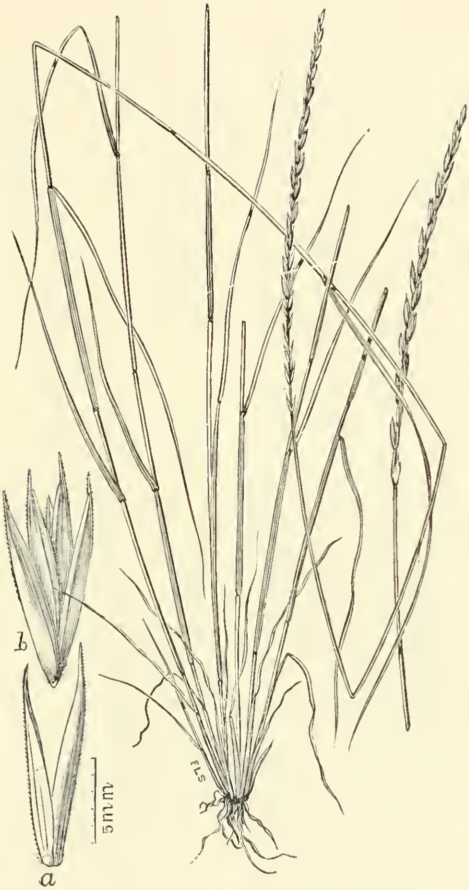

Fig. 593. **Agropyron tenerum** Vasey, Coult. Bot. Gaz. **10**: 258. 1885. Slender Wheat-grass.—An erect, cæspitose, rather stout, smooth perennial 6 to 9 dm. high, with narrow, flat leaves and slender, cylindrical spikes 8 to 15 cm. long. Outer glumes (*a*) 5-nerved; flowering glumes lanceolate 8 to 10 mm. long, tipped with a stiff, straight awn 1 to 4 mm. long.—Dry soil, New Mexico and southern California to Washington and British Columbia, and eastward to New Hampshire and Labrador. July, August.

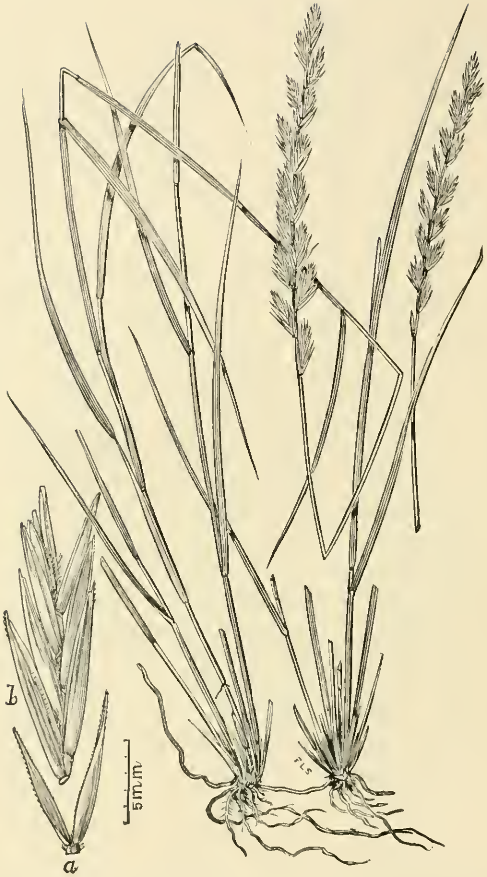

Fig. 594. **Agropyron spicatum** (Pursh) Scribn. & Smith, Bull. U. S. Dept. Agr., Div. Agros. **3**:12. 1896. Colorado Blue-stem. Western Wheat-grass.—A rigid, upright, glaucous perennial 3 to 12 dm. high, from creeping rootstocks, with rather firm, bluish-green leaves, and straight, beardless spikes 6 to 14 cm. long. Spikelets 7- to 13-flowered, 12 to 20 mm. long, with lanceolate, acuminate-pointed, empty glumes (*a*), and acute flowering glumes 8 to 12 mm. long.—Dry or moist soil, Wisconsin to Iowa, and westward to Washington, Texas, and Arizona. June–September.

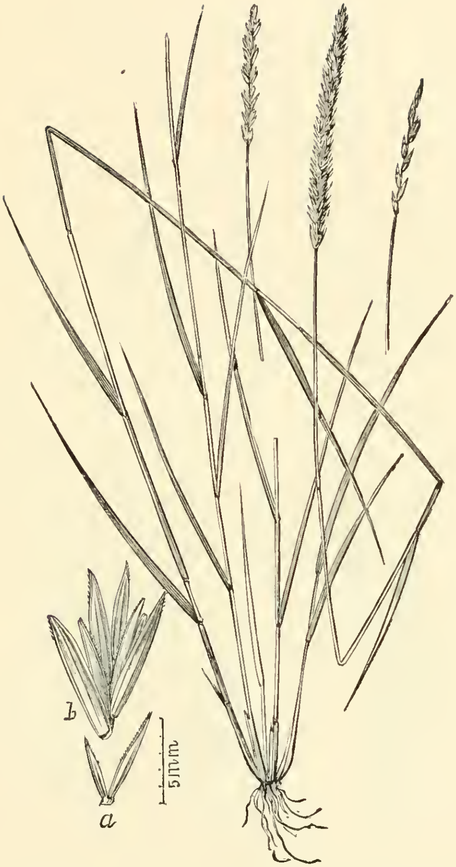

Fig. 595. **Agropyron riparium** Scribn. & Smith, U. S. Dept. Agr., Div. Agros., Bull. **4** : 35. 1897. River-side Wheat-grass.—A rather slender, tufted, glaucous perennial, 4.5 to 6 dm. high, with narrowly involute leaves, pubescent sheaths, and densely flowered spikes 5 to 8 cm. long. Spikelets 5- to 7-flowered, 10 to 12 mm. long, awnless. Empty glumes (*a*) less than one-half as long as the spikelet.—River banks, Montana. July, August.

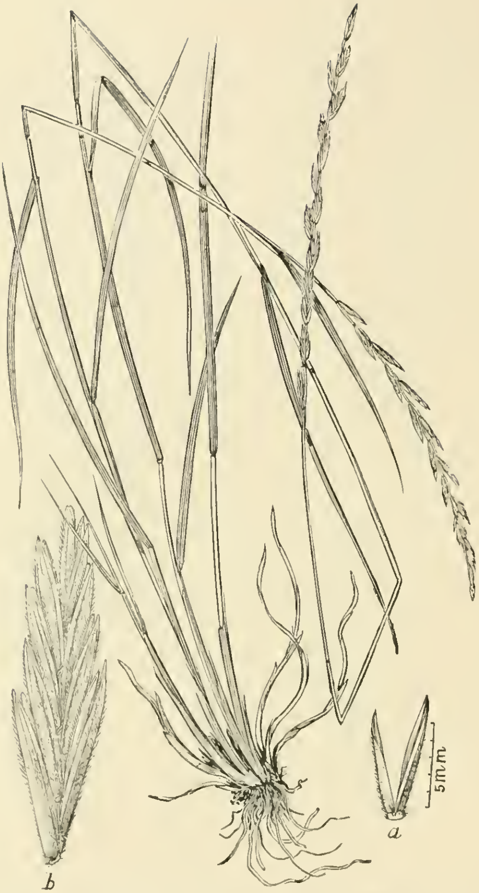

FIG. 596. **Agropyron lanceolatum** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull., **4**: 34. 1897. (*Triticum junceum* Hook. Not Linn.)—A rather stout, yellowish-green or glaucous perennial 6 to 9 dm. high, with long, flat leaves, with erect or flexuous spikes of large, subcompressed, acute, 4- to 7-flowered spikelets 10 to 20 mm. long. Empty glumes (*a*) abruptly acuminate, 6 to 9 mm. long; flowering glumes (shown in *b*) broadly lanceolate, rounded on the back and more or less pubescent.—Idaho to Oregon and Washington. May-July.

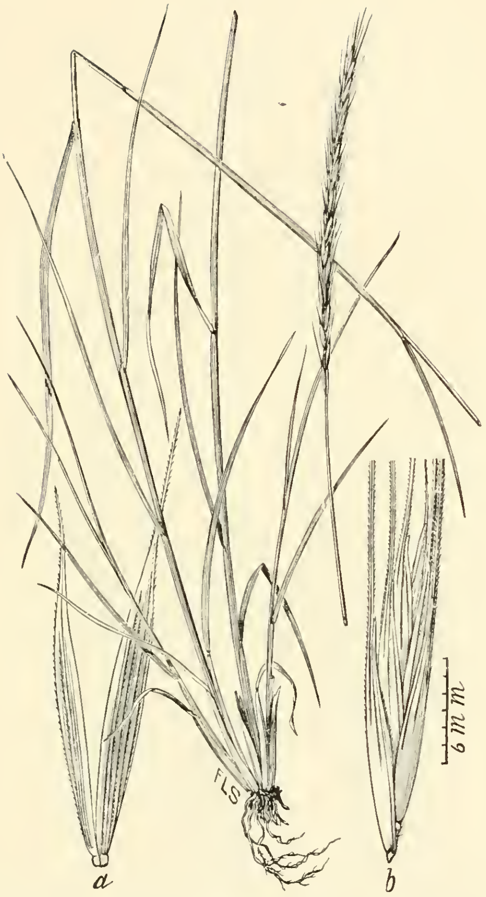

Fig. 597. **Agropyron richardsoni** Schrad. Linnæa **12**: 467. 1838, (fide Kew Index); (*Triticum richardsoni* Trin. in Reliq. in Schrad., Linn. **12**: 467. 1838.) Richardson's Wheat-grass.—An erect, smooth perennial, 6 to 8 dm. high, with rather rough, involute-pointed leaves and erect, usually one-sided, bearded spikes, 7 to 10 cm. long. Spikelets 3- to 4-flowered, with long-awned flowering glumes 8 to 9 mm. long.—Dry soil, Nebraska and Minnesota to the Saskatchewan, and south to Colorado. June–September.

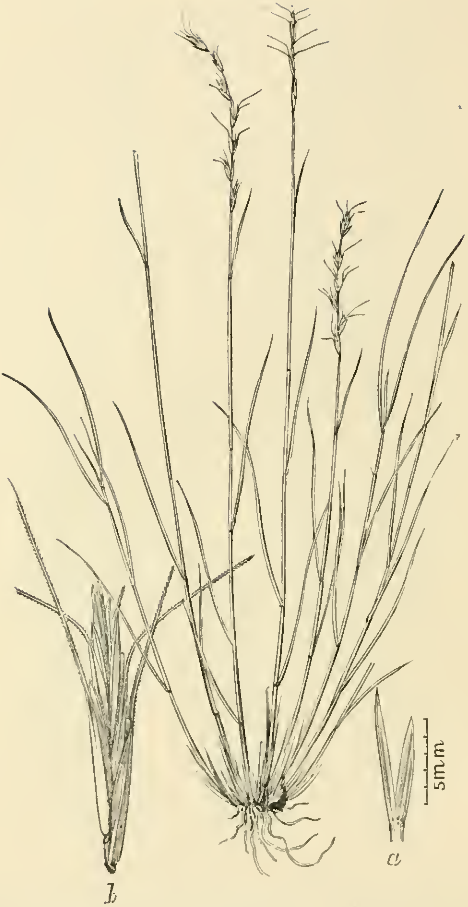

FIG. 598. **Agropyron vaseyi** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **4**: 27. 1897. VASEY'S BUNCH-GRASS.—A slender, wiry, erect, densely cæspitose perennial 3 to 4.5 dm. high, with short, involute, setaceous leaves, and few-flowered, interrupted spikes 4 to 8 cm. long. Spikelets rather remote, 3- to 5-flowered, 8 to 10 mm. long. Empty glumes awnless; flowering glumes with a divergent awn 8 to 10 mm. long.—Dry, gravelly soil, Montana and Nevada to Oregon and Washington. May-August.

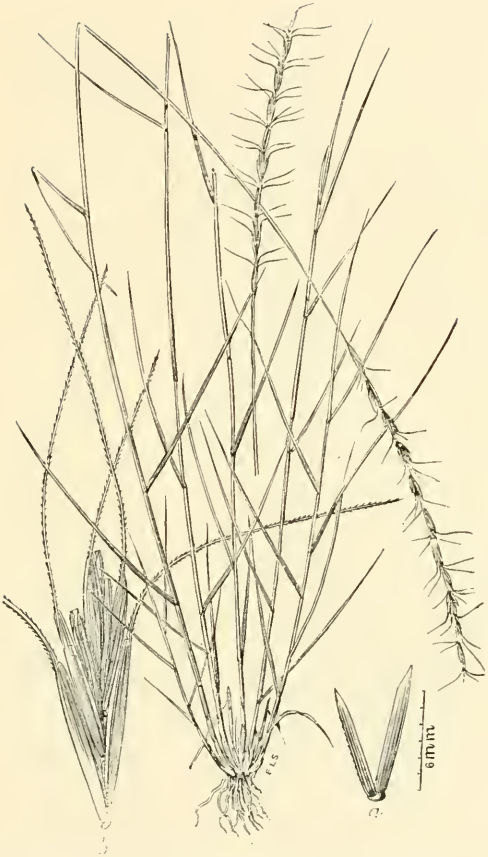

Fig. 599. **Agropyron divergens** Nees in Steud. Syn. Pl. Gram. 347. 1855. (*Triticum divergens* Steud.) Wire Bunch-grass.—A rigid and often wiry, densely tufted perennial 3 to 9 dm. high, with narrow, flat, or involute leaves, and terminal, usually erect spikes 8 to 20 cm. long. Spikelets rather distant, 3- to 6-flowered, with rigid and usually acute empty glumes (*a*) about one-half as long as the spikelet. Flowering glumes 8 to 10 mm. long with widely divergent arms.—Dry, rocky soil and bench lands, Washington and Oregon to Montana, Colorado and Nevada. June-August.

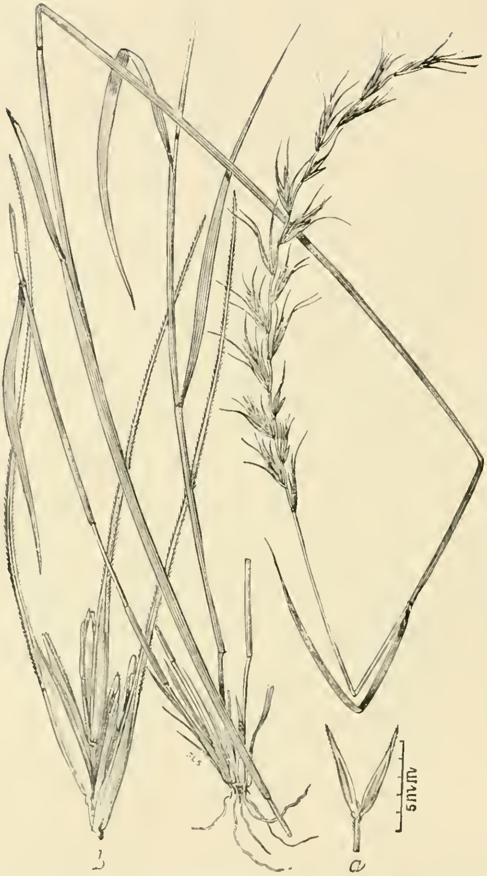

FIG. 600. **Agropyron arizonicum** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **4** : 27. 1897. ARIZONA WHEAT-GRASS.—A glaucous, erect perennial 4.5 to 6 dm. high, with soft, flat leaves 15 to 18 cm. long, nodding spikelets 12 to 22 cm. long, and rather remote, 5- to 7-flowered spikelets, 18 to 24 mm. long. Empty glumes (*a*) about one-half as long as the spikelets; flowering glumes long-awned; awn divergent, about 24 mm. long.—Mountains, New Mexico and Arizona. [Mexico.] August, September.

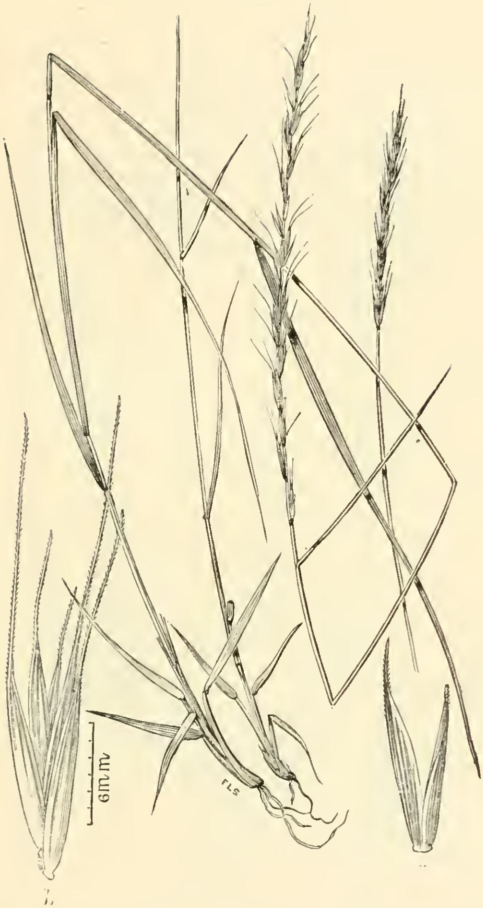

FIG. 601. **Agropyron gmelini** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. 8 Bull. **4** : 30. 1897. SHORT-LEAFED WHEAT-GRASS.—A rather slender, erect, glabrous, cæspitose perennial, 6 to 12 dm. high, with flat leaves, the lower ones short, and slender spikes 8 to 20 cm. long. Spikelets 7- to 9-flowered, 12 to 18 mm. long; empty glumes (*a*) unequal, two-thirds as long as the spikelet. Flowering glumes 10 to 12 mm. long, shorter than its slender awn.—Moist soil, mountains, Washington to western Nebraska. May–August.

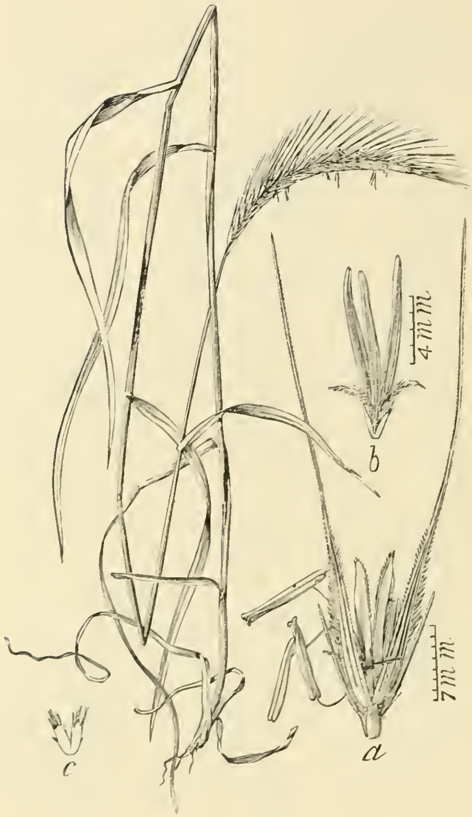

FIG. 602. **Secale montanum** Guss. Flor. Sic. Prod. 145. 1827. MOUNTAIN RYE.—A fibrous-rooted, erect, glabrous perennial, 9 to 12 dm. high, with flat leaves and nodding, somewhat compressed spikes 6 to 10 cm. long. Spikelets about 15 mm. long, with very narrow, awnless, or short-awned empty glumes and ciliate, 5-nerved, awned flowering glumes; awns 28 to 30 mm. long.—Sparingly introduced into cultivation. July.

Probably a good hay grass.

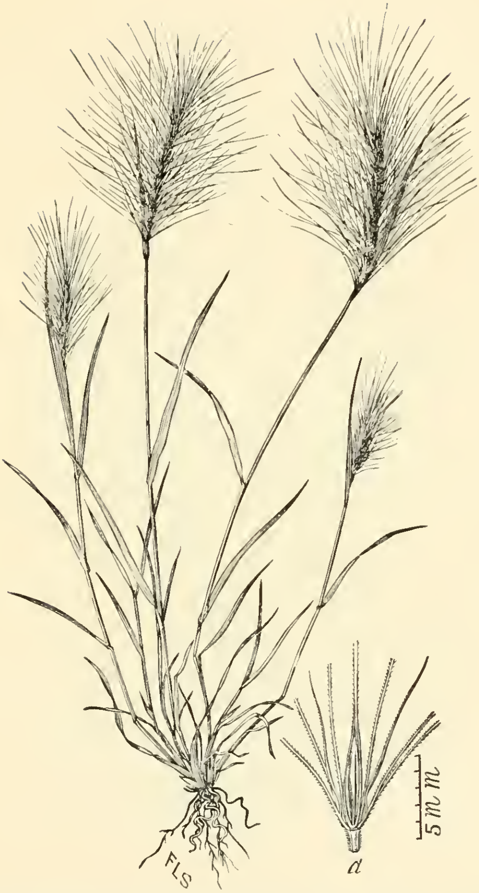

Fig. 603. **Hordeum jubatum** Linn. Sp. Pl. 85. 1753. Squirrel-tail Grass.—A smooth, slender, and erect perennial (?), 2 to 6 dm. high, with flat leaves, and long-bearded, nodding spikes 5 to 10 cm. long. Empty glumes awn-like, 3 to 5 cm. long, the flowering glume of the central spikelet 6 to 8 mm. long, terminating in a slender awn 3 to 5 cm. long.—Moist saline soils, Canada, the United States south to Kansas, Colorado, and California Alaska. May–August.

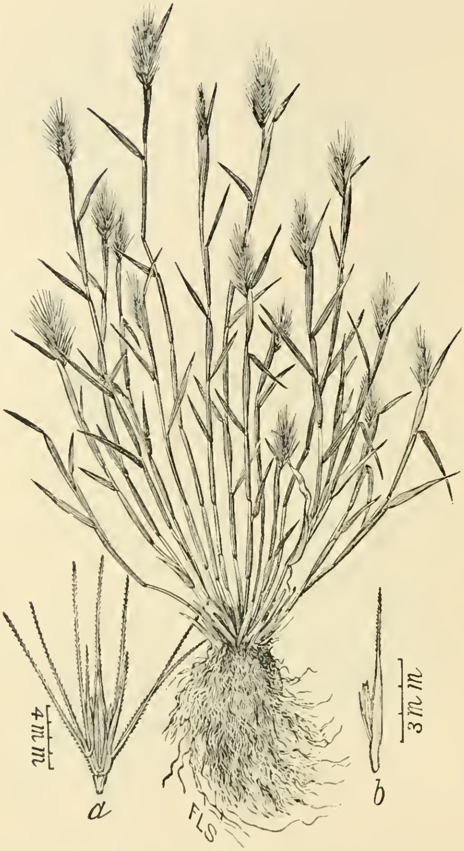

Fig. 601. **Hordeum maritimum** With. Bot. Arr. 172. 1776. Scribn. & Smith, U. S. Dept. Agr., Div, Agros. Bull. 4 : p. 24. 7189. Seaside Barley.—A smooth, upright, or spreading, cæspitose annual, 1 to 3 dm. high, with short leaves and terminal, bearded spikes 2 to 4 cm. long. Spikelets, including the rigid, spreading awns, 10 to 12 mm. long, the outer glumes not ciliate.—Sandy soil along the coast, British Columbia to southern California. [Naturalized from Europe.] May–July.

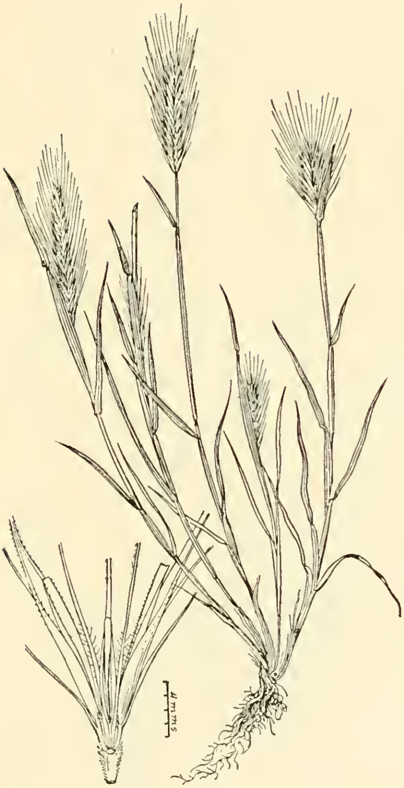

Fig. 605. **Hordeum murinum** Linn. Sp. Pl. 85. 1753. Wall Barley.—A rather stout, cæspitose annual, 3 to 6 dm. high, with short, flat leaves, inflated sheaths, and compressed spikes 5 to 10 cm. long. Spikelets, including the awns, 4 cm. long, the glumes of the middle spikelet lanceolate and conspicuously ciliate on the margins.—On ballast New York, New Jersey, and Delaware, and along the Pacific coast from British Columbia to southern California. [Europe.] April–July.

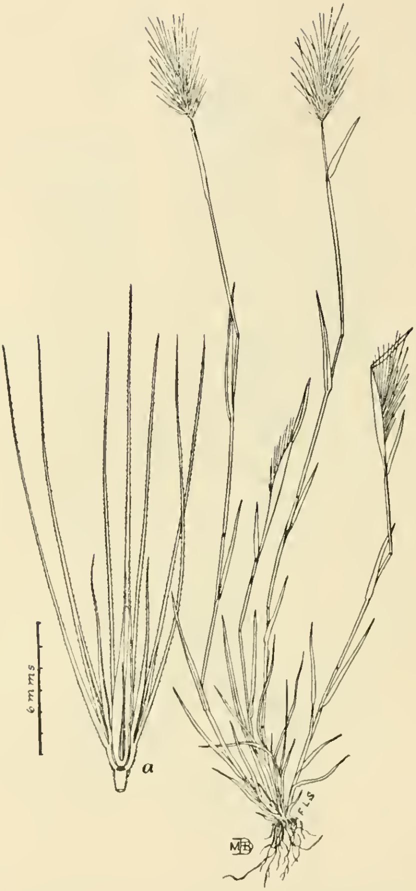

FIG. 606. **Hordeum gussonianum** Parl. Pl. Palerm. in obs. 244. 1845.—A slender, cæspitose, erect or ascending annual, 1 to 3 dm. high, with short leaves and spikes. Empty glumes subulate, long-awned, the inner pair distinctly flattened. Resembling *H. maritimum* in habit.—California and Oregon. [Europe.] May. June.

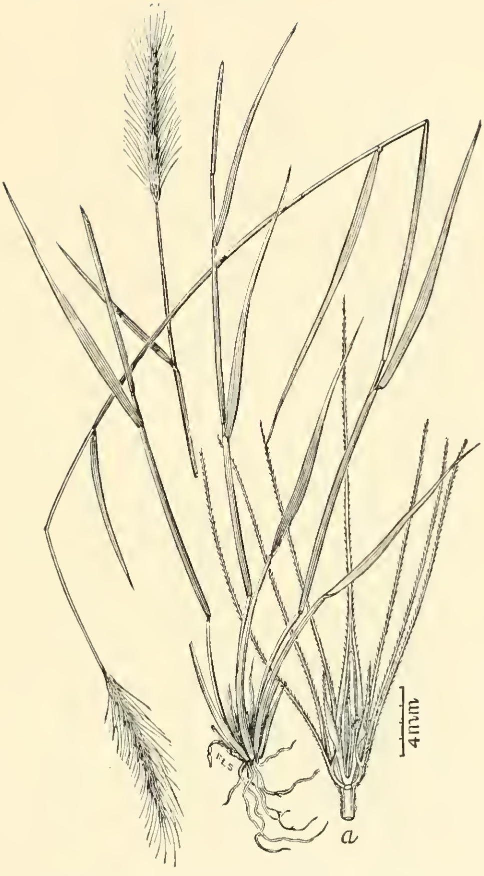

FIG. 607. **Hordeum adscendens** HBK. Nov. Gen. **1**: 180. 1815. Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **4**: 24. 1897.—A rather slender, erect, leafy annual (?) 6 to 9 dm. high, with pubescent lower sheaths, flat and rather rigid leaves, and bearded, terminal spikes 6 to 8 cm. long. Empty glumes setaceous, rounded on the back, grooved on the inner face below; those of the central spikelet about 2 cm. long. Flowering glume of the central spikelet 9 to 10 mm. long, with an awn 20 to 24 mm. long. Lateral spikelets neutral.—Along irrigating ditches, Arizona. [Mexico.] April–June.

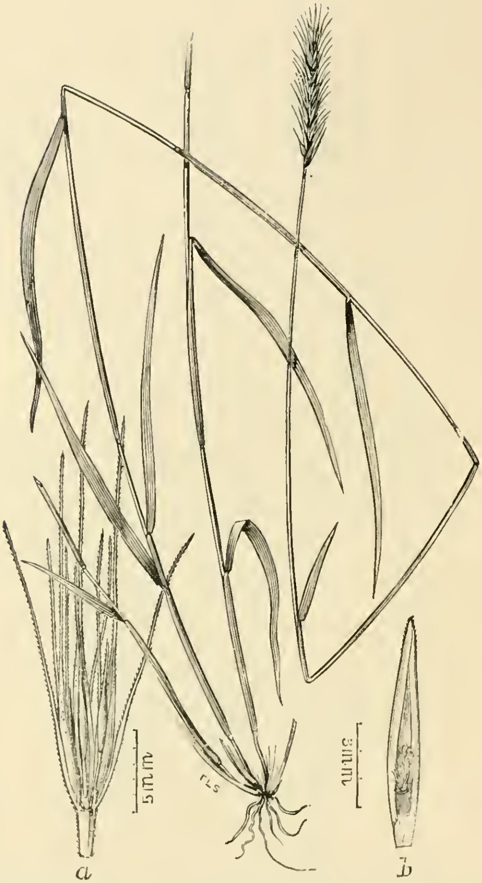

FIG. 608. **Hordeum montanense** Scribn. in Beal Grasses N. Am. **2** : 614. 1896. MONTANA BARLEY.—An erect, leafy biennial or perennial 6 to 9 dm. high, with smooth culms, scabrous leaves and bearded spikes 4 to 6 cm. long. Empty glumes linear-lanceolate, 12 to 20 mm. long, including the slender, scabrous awns. The central spikelet of each group usually 2-flowered. First flowering glume about 10 mm. long, awned. Awn 16 to 18 mm. long. Lateral spikelets 2-flowered, florets nearly sessile.—Moist thickets, Montana.

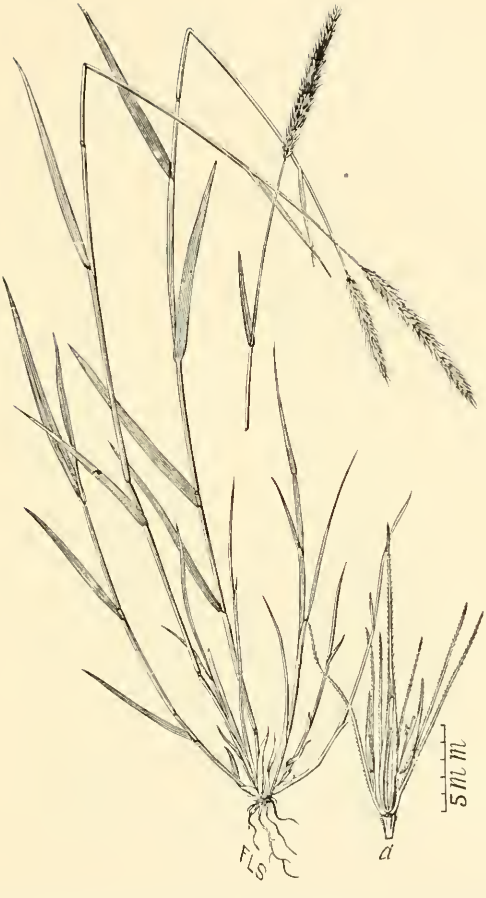

Fig. 609. **Hordeum nodosum** Linn. Sp. Pl. Ed. 2, 56. 1762. Wild or Meadow Barley.—A slender, erect, cæspitose grass 2 to 6 dm. high, with flat leaves, and narrow, bearded spikes 2 to 8 cm. long. Empty glumes all setaceous or awn-like; lateral spikelets imperfect. Awns 6 to 12 mm. long.—Thin, dry soils, Indiana and Minnesota to Alaska, and south to Tennessee, Mississippi, Texas, and California. May–August.

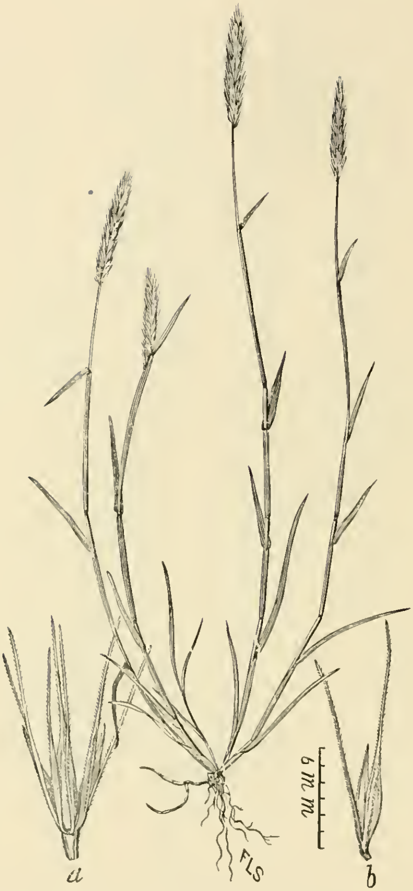

Fig. 610. **Hordeum pusillum** Nutt. Gen. **1**: 87. 1818. Little Barley.—A slender, rather rigid, erect, glabrous perennial, 1 to 3.5 dm. high, with comparatively short, flat leaves, and terminal spikes 2 to 7 cm. long. Outer glumes of the central spikelets and lower ones of the lateral spikelets much broadened above the base.—Arid, saline, or alkaline soils from Ontario to British Columbia and south to South Carolina, Louisiana, and Texas. April–August.

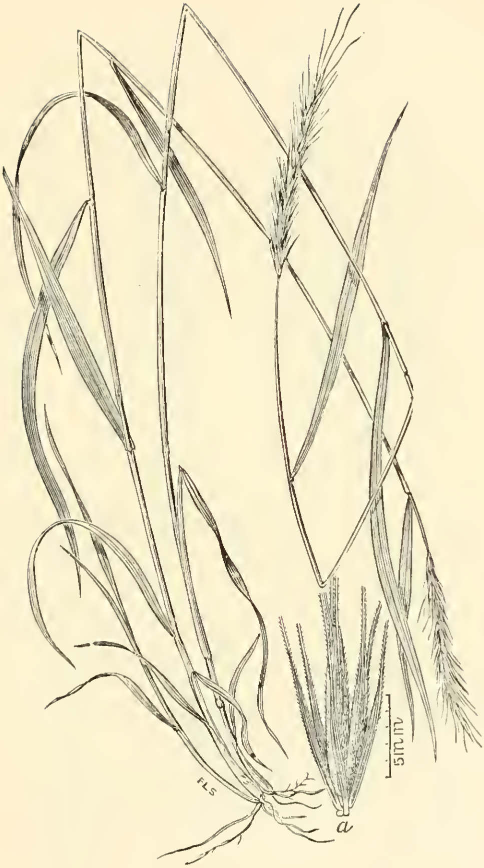

FIG. 611. **Elymus striatus** Willd. Sp. Pl. **1**: 470. 1797. SLENDER LYME-GRASS.—A rather slender, erect, leafy perennial with flat leaves and slender, bearded, somewhat nodding spikes 7 to 10 cm. long. Spikelets 1- to 3-flowered, with awl-shaped, hispid or hirsute empty glumes and scabrous, slender-awned flowering glumes about 6 mm. long. Awns 16 to 30 mm. long.—Woods and river banks, Maine to South Dakota and south to New Jersey, Tennessee, Arkansas, and Texas. June–August.

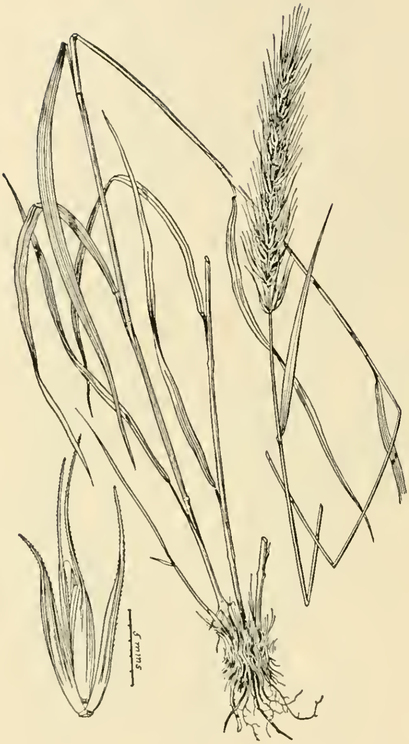

FIG. 612. **Elymus virginicus** Linn. Sp. Pl. 84. 1753. TERRELL-GRASS.—A rather stout, leafy, erect, glabrous perennial 6 to 10 dm. high, with terminal, erect spikes 4 to 14 cm. long, the bases of which are usually inclosed in the inflated uppermost sheath. Spikelets with thick and rigid, lanceolate empty glumes 16 to 24 mm. long (including the short awn).—Moist soil, borders of thickets and open woodlands, Nova Scotia and New Brunswick to Florida, and westward to Manitoba and Texas. June–September.

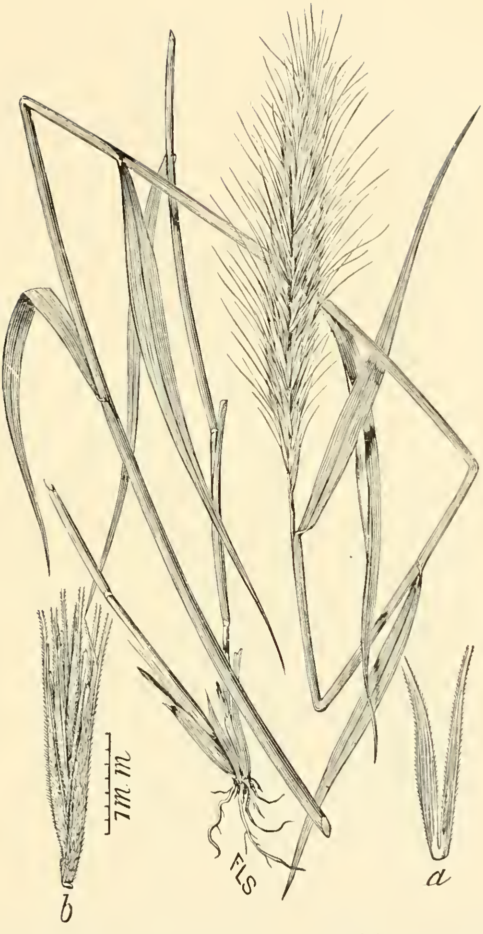

FIG. 613. **Elymus robustus** Scribn. & Smith. U. S. Dept. Agr., Div. Agros. Bull. **4** : 37. 1897. GREAT LYME-GRASS.—A stout, leafy perennial 9 to 18 dm. high, with thick, terminal, long-bearded spikes 10 to 14 cm. long. Spikelets 3- to 4-flowered, with linear-subulate empty glumes and scabrous or pubescent flowering glumes. Awns spreading 3 to 4 cm. long.—Rich moist soil, Illinois, and Montana to Kansas and New Mexico. June-September.

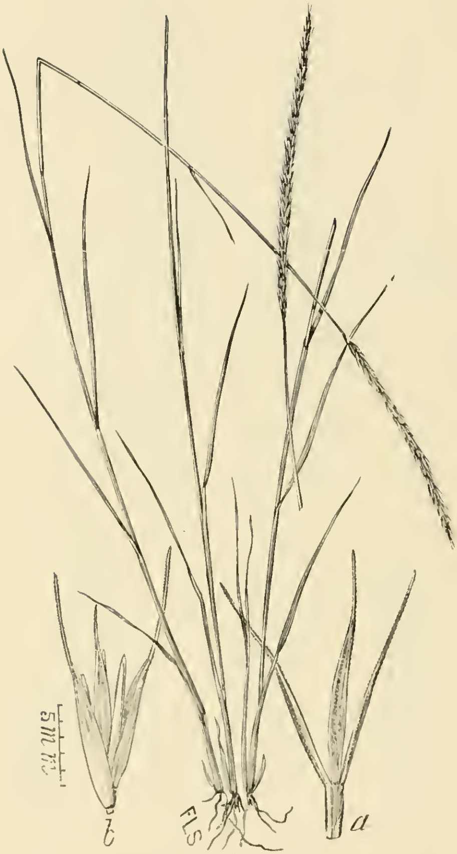

FIG. 614. **Elymus macounii** Vasey, Bull. Torr. Bot. Club, **13**: 119. 1886. MACOUN'S LYME-GRASS.—A slender, upright, smooth, cæspitose perennial 3 to 8 dm. high, with narrow, erect leaves and slender, nearly cylindrical spikes 6 to 10 cm. long. Spikelets 1- to 3-flowered, with narrowly lanceolate empty glumes (*a*) 8 to 10 mm. long.—Rather moist soil, South Dakota to Colorado and Montana. [British Columbia.] June–August.

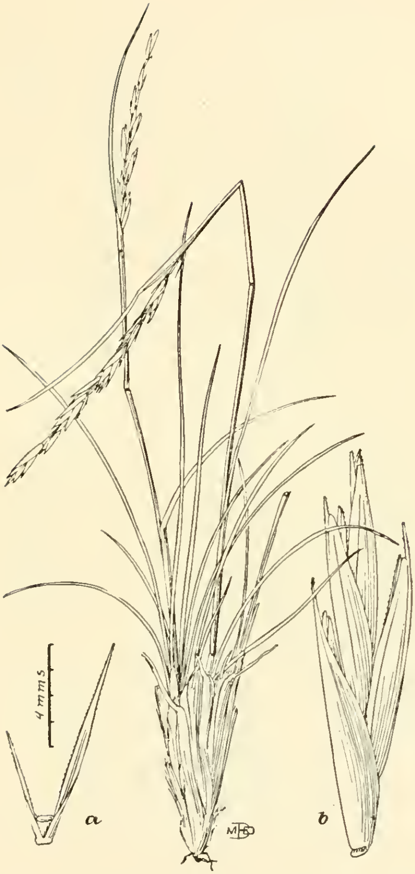

FIG. 615. **Elymus salinus** Jones, Proc. Cal. Acad., ser. 2, **5**: 725. 1895. ALKALI LYME-GRASS.—A rigid, wiry, erect, densely cæspitose perennial 3 to 6 dm. high, with rather rigid, involute, spreading leaves and narrow, erect spikes 5 to 10 cm. long. Spikelets usually single at each joint, about 12 mm. long and 5- to 9-flowered. Empty glumes (*a*) nearly subulate, unequal; flowering glumes short-awned, about 8 mm. long.—Alkali soil, Utah and Wyoming. June-August.

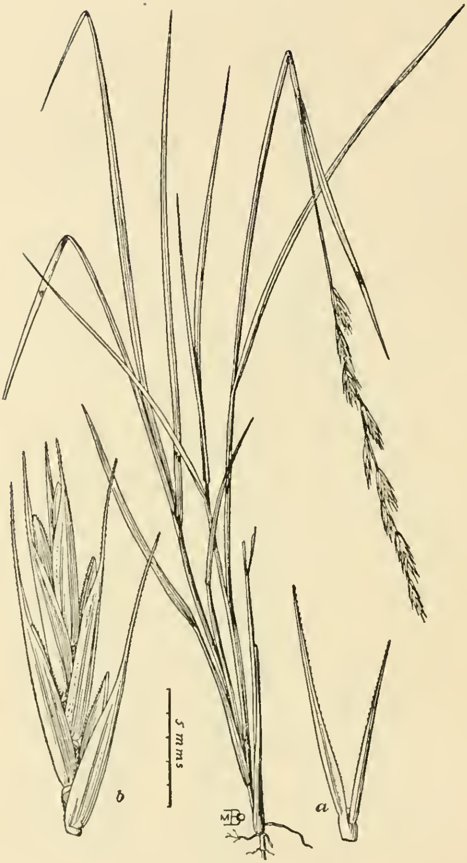

Fig. 616. **Elymus simplex** Scribn. and Williams. U. S. Dept. Agr., Div. Agros. Bull. **11**:57, pl. 17. 1898. Salt Lyme-grass.—A wiry, erect perennial, 3 to 4 dm. high, from strong, creeping rootstocks, with flat (finally involute) pungently-pointed, rigid leaves and densely-flowered, erect spikes 5 to 8 cm. long. Spikelets solitary or in pairs, 5- to 7-flowered, about 15 mm. long, with very rigid and subulate-pointed empty glumes and smooth flowering glumes, which are about 7 mm. long, with rigid awns 5 to 6 mm. long.—Borders of ponds, Wyoming. July, August.

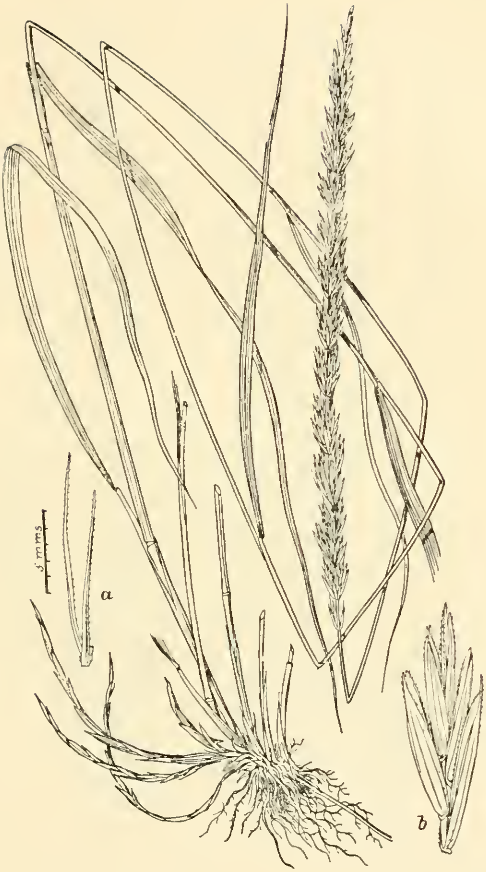

Fig. 617. **Elymus condensatus** Presl, Reliq. Haenk. **1** : 265. 1830. Giant Rye-grass.—A stout, erect perennial 10 to 24 dm. high, often growing in great clumps or bunches, with long, rather rigid, flat leaves and dense spikes 10 to 30 cm. long. Spikelets 3 to 6 flowered, with subulate empty glumes (*a*) and smooth, mucronate-pointed flowering glumes 8 to 10 mm. long.—Usually moist and alkaline soils, Nebraska and the Dakotas to Washington and Oregon, south to Arizona and California. June–September.

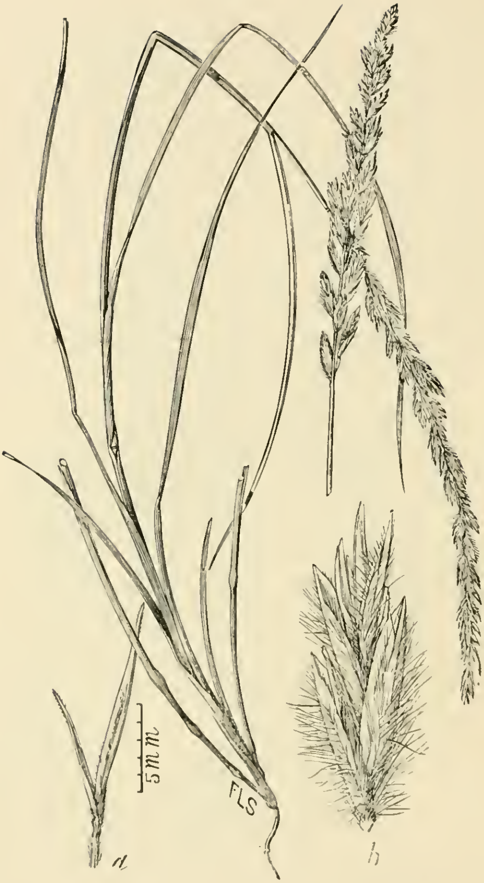

FIG. 618. **Elymus flavescens** Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **8** : 8, fig. 1. 1897. YELLOW-HAIRED LYME-GRASS.—A stout, erect perennial 6 to 10 dm. high, from long, creeping rootstocks, with long, somewhat rigid leaves and rather loosely-flowered yellowish spikes 10 to 20 cm. long. Spikelets 3- to 6-flowered, 10 to 20 mm. long, densely villous, with long whitish or yellowish hairs. Glumes awnless, the outer ones very unequal and glabrous.—Dry sandy soil, Idaho to Oregon and Washington. May, June.

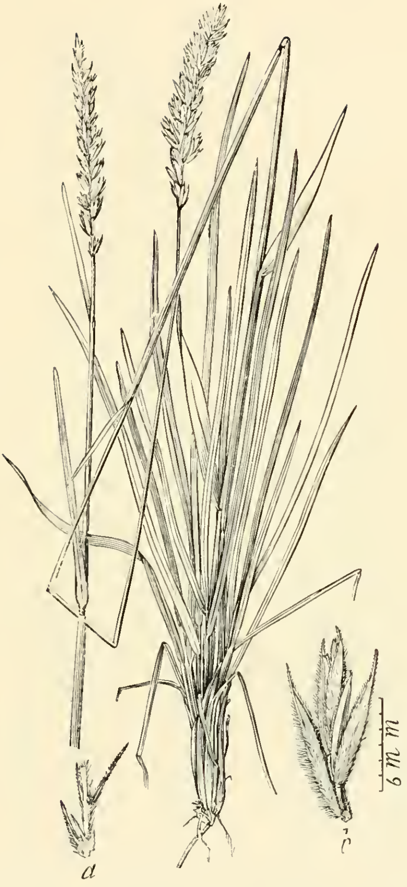

Fig. 619. **Elymus innovatus** Beal, Grasses of North America, **2** : 650. 1896. (*Elymus brownei* Scribn. & Smith, U. S. Dept. Agr., Div. Agros. Bull. **8** : 7, Pl. IV.) Brown's Wild Rye.—A rigid, rather slender, erect perennial 5 to 9 dm. high, with short cauline leaves, and densely flowered, pubescent spikes 4 to 10 cm. long. Spikelets 3- to 6-flowered, 10 to 15 mm. long, with densely pubescent flowering glumes 8 to 10 mm. long.—Gravelly or sandy banks, South Dakota, Wyoming, British Columbia, and northward to Alaska. June–September.

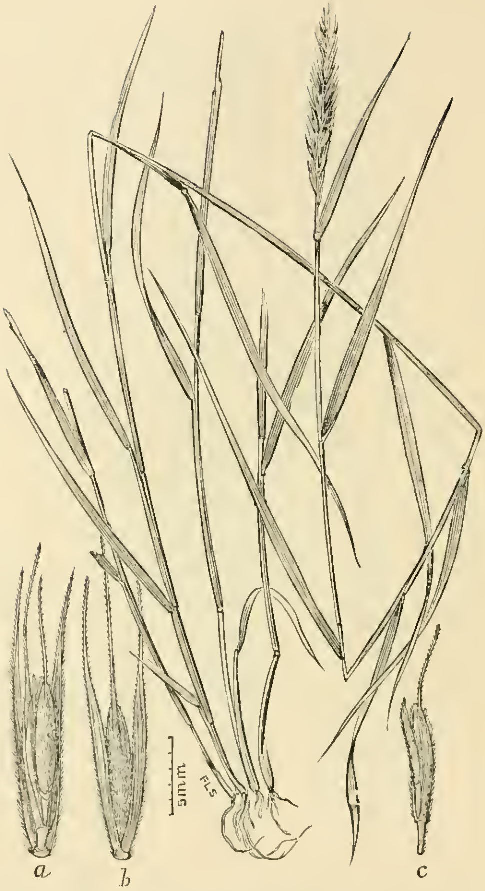

FIG. 620. **Elymus hirsutiglumis** Scribn. U. S. Dept. Agr., Div. Agros. Bull. **11**: 58. 1898. (*E. intermedius* Scribn. & Smith, U. S. Dept. Agr., Div. Agros, Bull. **4**: 38. 1897. Not *E. intermedius* Bieb., Flor., **1**: 82.) HAIRY-FLOWERED LYME-GRASS.—A rather stout, erect, leafy perennial 6 to 9 dm. high, with smooth culms and sheaths, and erect, slender spikes 3 to 8 cm. long. Empty and flowering glumes awn-pointed; awns 8 to 16 mm. long.—Maine to Virginia and westward to Illinois and Nebraska. July, August.

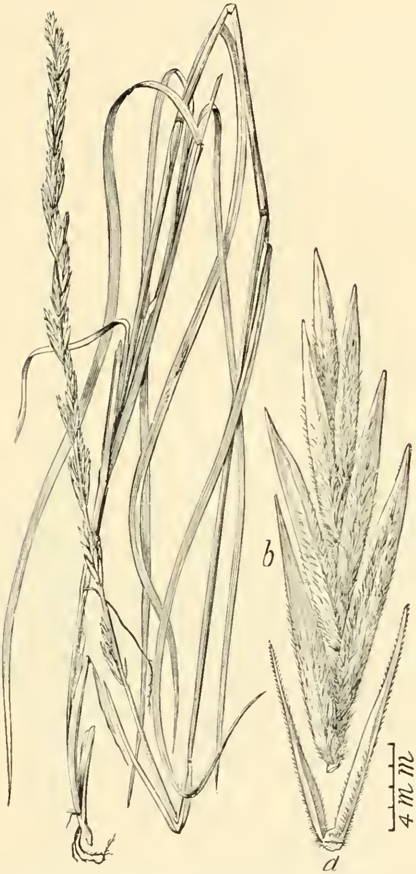

FIG. 621. **Elymus dasystachys littoralis** (Pall.) Griseb. Ledb. Flor. Ross. **4**: 333. 1853. Scribn. U. S. Dept. Agr., Div. Agros. Bull. **8**: 8. (*Triticum littorale* Pall. It. **3**: 287.) 1776.—A stout, erect perennial 8 to 10 dm. high, from strong, creeping rootstocks, with long, sharp-pointed leaves, and loosely flowered, often branched spikes 20 to 30 cm. long. Spikelets 5- to 9-flowered, with rigid, narrowly lanceolate empty glumes (*a*), and acute flowering glumes which are 12 to 14 mm. long and pubescent on the back, excepting near the apex.—Washington and Idaho. August.

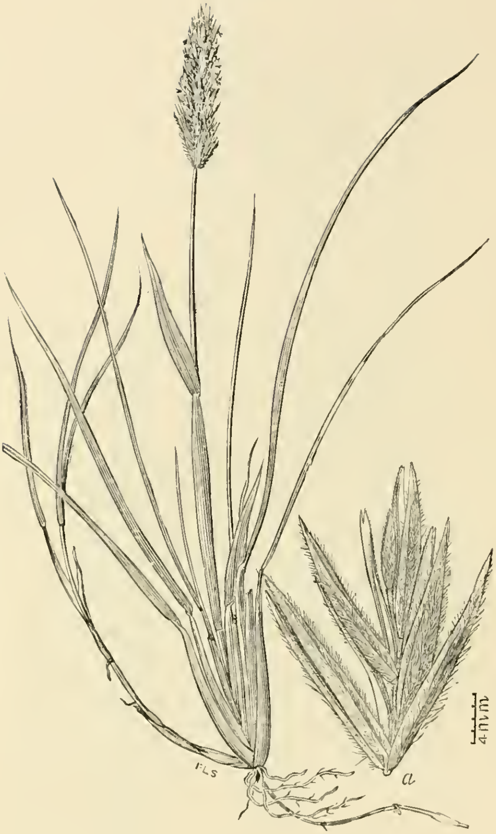

FIG. 622. **Elymus villosissimus** Scribn. sp. nov. NORTHERN LYME-GRASS.—A stout, erect perennial 3 to 4 dm. high from a strong, creeping rootstock, with rather broad, comparatively short, flat leaves, and short, densely flowered panicles 5 to 7 or 8 cm. long. Spikelets (*a*) 3-to 5-flowered, about 15 cm. long, with densely villous or lanate glumes, the outer ones narrowly lanceolate and subulate-pointed, nearly equaling the spikelet. Ligule nearly obsolete.—Uplands, St. Paul Island, Bering Sea; also Wrangell Island, Arctic America.

Type specimen from St. Paul Island. James M. Macoun (16226). July, August.

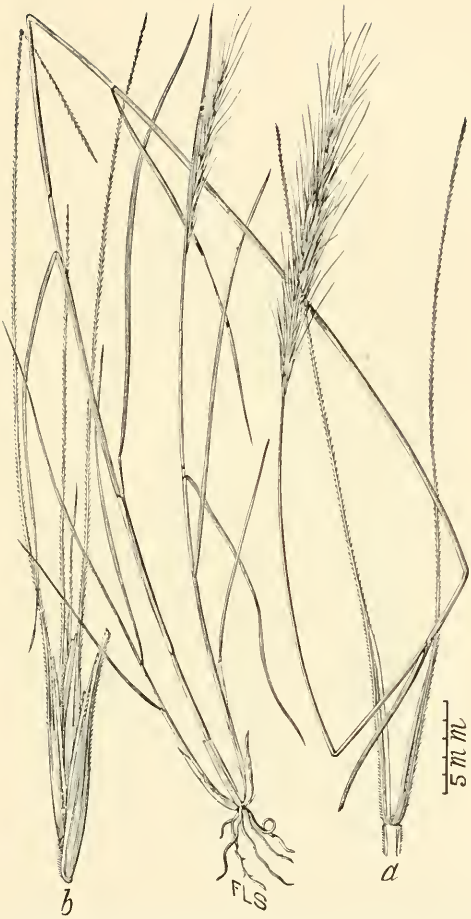

FIG. 623. **Elymus saundersii** Vasey, Bull. Torr. Bot. Club, **2**: 126. 1884. SAUNDERS LYME-GRASS.—A slender, tufted, erect perennial 6 to 10 dm. high, with narrow, rather rigid leaves and long-bearded spikes, 10 to 14 cm. long. Spikelets 2-to 4-flowered; awns of the glumes slender, 40 to 50 mm. long; lower flowering glume about 10 mm. long, 2-toothed at the apex.—Veta Pass, Colorado.

Axis of the spike readily breaking up, as in *Sitanion*.

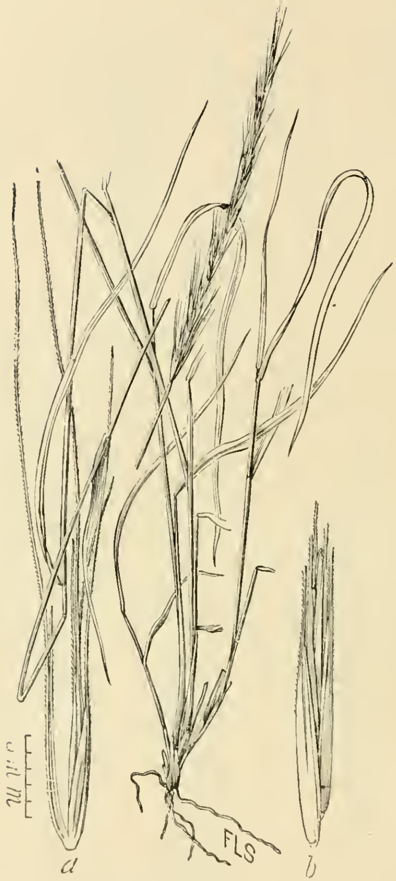

FIG. 624. **Sitanion hanseni** (Scribn.) J. G. S. n. comb. (*Elymus hanseni* Scribn., U. S. Dept. Agr., Div. Agros. Bull. **11**: 56, fig. 12 1898). HANSEN'S SITANION.—A rather stout, glabrous perennial 9 to 12 dm. high, with narrow, spreading leaves and slender, fragile spikes 5 to 8 cm. long. Leaves 10 to 30 cm. long. Spikelets 3- to 5-flowered, about 15 mm. long, exclusive of the awns, which are 2 to 5 cm. long. Empty glumes tipped with 2 or sometimes 3 unequal awns, the longer ones often 3.5 cm. long.—Dry, open grounds, Amador County, California.

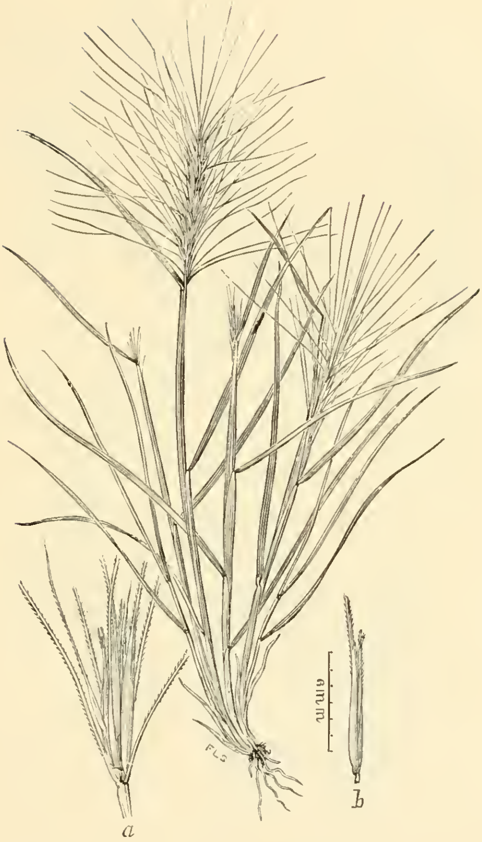

Fig. 625. **Sitanion glaber** J. G. Smith. sp. nov. ORCHARD BARLEY.—A rather stout, erect, densely cæspitose perennial, 3 to 5 dm. high, with the sheaths and under side of the leaves glabrous, the long-bearded spikes 5 to 8 cm. long. Awns of the floral glumes 40 to 50 mm. long.—California to Washington.

Type No. 914, Coville and Funston, from Coso Mountains, California.

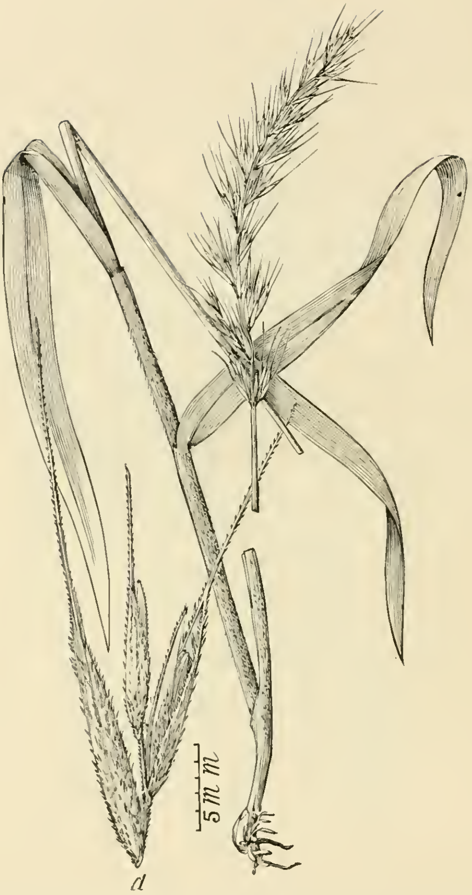

FIG. 626. **Asperella californica** (Bol.) Beal, Grasses N. Am. **2**: 657. 1896. (*Gymnostichum californicum*, Boland. Cat. 35. 1870.) CALIFORNIA BOTTLE-BRUSH.—A stout, erect perennial, 10 to 20 dm. high, with hirsute lower sheaths, broad, flat leaves, and terminal, bearded spikes 15 to 25 cm. long. Spikelets 1- to 3-flowered, with nearly obsolete empty glumes and strongly hispid flowering glumes terminated in a stout, rough awn nearly as long as the glume itself.—California.

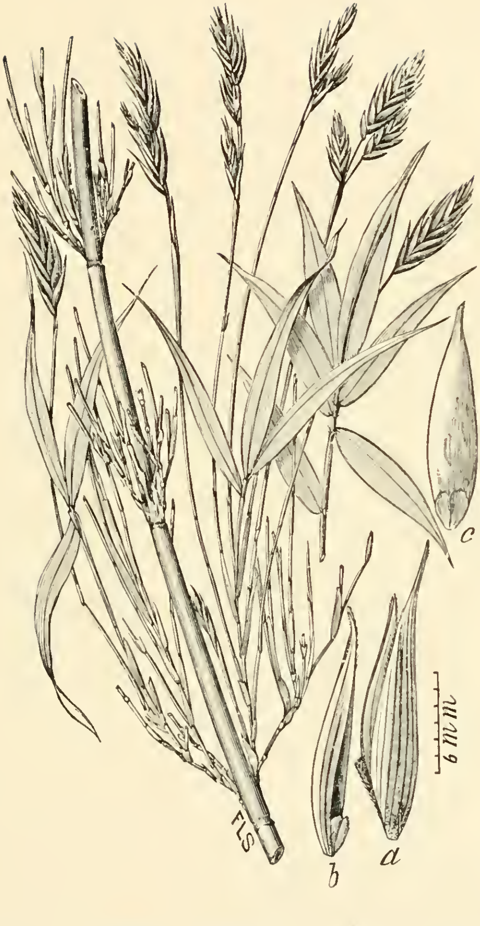

FIG. 627. **Arundinaria macrosperma** Michx. Flor. Bor. Am. **1**: 74. 1803. CANE.—A stout, woody, almost arborescent grass 45 to 90 dm. high, with lanceolate leaves and lateral panicles composed of a few simple racemes. Spikelets 25 to 45 cm. long, 5- to 9-flowered, with short empty glumes and lanceolate, short-awned, flowering glumes about 16 mm. long.—North Carolina to Florida and westward to Texas.

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BULLETIN NO. 18. Agros. 46.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

STUDIES
ON
AMERICAN GRASSES.

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A SYNOPSIS OF THE GENUS SITANION.

BY

JARED G. SMITH.

PREPARED UNDER THE DIRECTION OF F. LAMSON-SCRIBNER, AGROSTOLOGIST.

ISSUED JUNE 24, 1899.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., May 3, 1899.

SIR: I have the honor to transmit herewith the manuscript of a paper entitled "Synopsis of the genus *Sitanion*," prepared under my direction by Mr. Jared G. Smith, assistant agrostologist, and recommend the same for publication as Bulletin No. 18 of this division under the general title of "Studies on American Grasses."

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

HON. JAMES WILSON,
Secretary of Agriculture.

INTRODUCTION.

The many and striking differences presented by the specimens which have been referred to *Sitanion hystrix* (*Elymus sitanion*) have long been recognized, but no one has heretofore attempted to define or classify them. From the material in the herbarium of the Academy of Natural Sciences of Philadelphia, it is evident that Nuttall distinguished at least two species. These are shown in Plate 1, the tickets attached to the specimens being in Nuttall's handwriting. The large amount of material in the National Herbarium, gathered from numerous and widely separated localities by many collectors, has afforded an excellent opportunity for a study of the variations which with the increase of the collection became more and more apparent, and the necessity of their classification more and more evident. The present paper, prepared by my direction, was undertaken to meet this necessity, and while the species here defined may require some modification after further studies in the field, and while some classed as species may eventually be reduced to varieties, the subject as presented can hardly fail to be of interest to the student of grasses and helpful in the close discrimination of the species of a critical group of plants.

Nuttall,[1] who first described the species of this genus, referred it to the European *Ægilops* and named his plant *Ægilops hystrix*. His description was carefully drawn up and his species can be readily recognized. A year later, Rafinesque[2] published his genus *Sitanion*, based upon a single species, which he named *Sitanion elymoides*. It has been found impossible to determine with certainty which of the species enumerated in the present paper was the one named by Rafinesque; it certainly was not, however, the grass described by Nuttall.

Our leading authorities, Bentham and Hooker,[3] Hackel,[4] and Baillon,[5] have all reduced *Sitanion* to a section of *Elymus*. The articulate rachis, readily breaking up at maturity, and the usually bifid or many parted and awned empty glumes are well-defined characters, distinguishing the species from *Elymus*, and justifying their separation as a distinct genus. To be sure there are species so closely connecting *Elymus* with *Sitanion* that it is difficult to determine to which genus they ought to be referred, but the same is true in the case of *Elymus* and *Agropyron;* there are intermediates which may with equal propriety be placed either in the one genus or the other.

---

[1] Genera North American Plants, **1**: 86. 1818.

[2] Journ. Phys., **89**: 103. 1819.

[3] Genera Plantarum **3**: p. 1207.

[4] Die Natürlichen Pflanzenfamilien **2**: part 2, p. 88.

[5] Histoire des Plantes, Monographie des Graminées, 258.

That there are forms connecting *Sitanion* with *Elymus* indicates their close relationship, but this fact does not afford sufficient reason for uniting them, and the paper here presented, describing the many species into which *Sitanion* may be divided, affords good evidence and ample justification for its separation.

F. LAMSON-SCRIBNER.

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A SYNOPSIS OF THE GENUS SITANION.

CHARACTERS OF THE GENUS.

SITANION Rafinesque, in Journ. Phys., **89**: 103, 1819.
Ægilops Nutt., Gen. N. Am. Pl., **1**: 86, 1818; not Linn. (1737.)
Polyantherix Nees, in Ann. Nat. Hist., Ser. I, **1**: 284, 1838.

Cæspitose perennials with intravaginal innovations. Rhachis of the spike articulating at the nodes; spikelets rarely 1, usually 2, or sometimes 3 at each node, each subtended by 2 persistent empty glumes. Empty glumes all subulate, setaceous and entire; or lanceolate and bifid; or many-parted from near the base; with recurving or spreading, scabrous awns terminating each lobe. Flowering glumes all alike, lanceolate, acute, or that of the lowest floret sterile and resembling the subulate-setaceous long-awned empty glumes; entire or with a single terminal recurving or spreading awn, or trifid and 3-awned. Inflorescence a spike, or very rarely spiciform-paniculate. A genus endemic to western North America, containing 23 species.

NOTE: **Sitanion**, section *Elymoides*, consists of 4 species intermediate between this genus and *Elymus*. They are placed here tentatively, as being more closely allied to *Sitanion*.

ANALYTICAL KEY TO THE SPECIES.

* Empty glumes many-lobed; lowest floret sterile, subulate-setaceous.
  † Culms robust, 6–9 dm. high, spike and florets large; awn of the flowering glume 8–10 cm. long .... 1. *S. jubatum.*
  †† Culms 1–5 dm. high; spike and florets medium or small; awn of the flowering glume 2–7 cm. long.
    ‡ Leaves short, flat, divergent; the blades and sheaths villous. 2. *S. villosum*
    ‡‡ Leaves long, erect or ascending, involute, strigose or pubescent.
      = Awns of the empty and flowering glumes about as long as the axis of the spike .... 3. *S. multisetum.*
      = = Awns of the empty and flowering glumes shorter than the axis of the spike.
        a Leaves of the innovations involute, filiform, pilose. 4. *S. polyantherix.*
        b Leaves of the innovations involute, rather rigid, strigose. 5. *S. breviaristatum.*

** Some of the empty glumes 2-nerved, bifid from about the middle, the lobes abruptly divergent; lowest floret of one or both spikelets sterile and like the empty glumes, but inserted on the rhachilla and falling away with it.
  † Only one spikelet at each joint with fertile florets .... 6. *S. minus.*
  †† Both spikelets bearing fertile florets.
    ‡ Sheaths and dorsal surface of leaves glabrous; glaucous.
      a Low alpine plants .... 7. *S. rigidum.*
      b Erect, densely cæspitose .... 9. *S. glabrum.*
      c Erect, slender; flowering glume half as long as its awn. 10. *S. insulare.*
      d Slender; innovations very numerous .... 13. *S. cæspitosum.*

‡‡ Leaves dorsally pubescent or scabrous.
§ Awn 2 to 3 times as long as the flowering glume. 11. *S. cinereum.*
§§ Awn at least 4 times as long as the flowering glume.
1. Innovations very numerous; culms slender. 12. *S. hystrix.*
2. Innovations few; culms robust.
a Culm leaves 2–8 cm. long; flat, rigid, obtuse, divaricate. 8. *S. californicum.*
b Culm leaves 1–2.5 dm. long, flexuous; flowering glume scabrous.......................... 15. *S. strigosum.*
c Culm leaves short, rigid, ascending, 5–10 cm. long; flowering glume smooth below, scabrous above. 14. *S. montanum.*
d Culm leaves rigid; flowering glume glabrous. 16. *S. molle.*

*** Empty glumes subulate-setaceous, entire; lowest floret hermaphrodite.
a Culm leaves very long, flexuous, filiform-involute........ 18. *S. longifolium.*
b Culm leaves short, rigid, spreading, or horizontally divaricate.
1 Flowering glume 1 cm. long, glaucous; culms robust. 17. *S. brevifolium.*
2 Flowering glume 7 mm. long, soft pubescent; culms low. 19. *S. pubiflorum.*

**** Empty glumes lanceolate, 2–5-nerved, entire or lobed.
+ Lowest floret longer than the internodes of the rachis.
‡ Leaves flat, glaucous, more strongly nerved on the back than above, 5–8 mm. wide .... 20. *S. planifolium.*
‡‡ Leaves involute, more prominently nerved above than on the back, 2–3 mm. wide .... 21. *S. lanceolatum.*
++ Internodes of the rachis longer than the lowest floret.
1 One spikelet at each node..................... 22. *S. hanseni.*
2 Two spikelets at each node................. 23. *S. anomalum.*

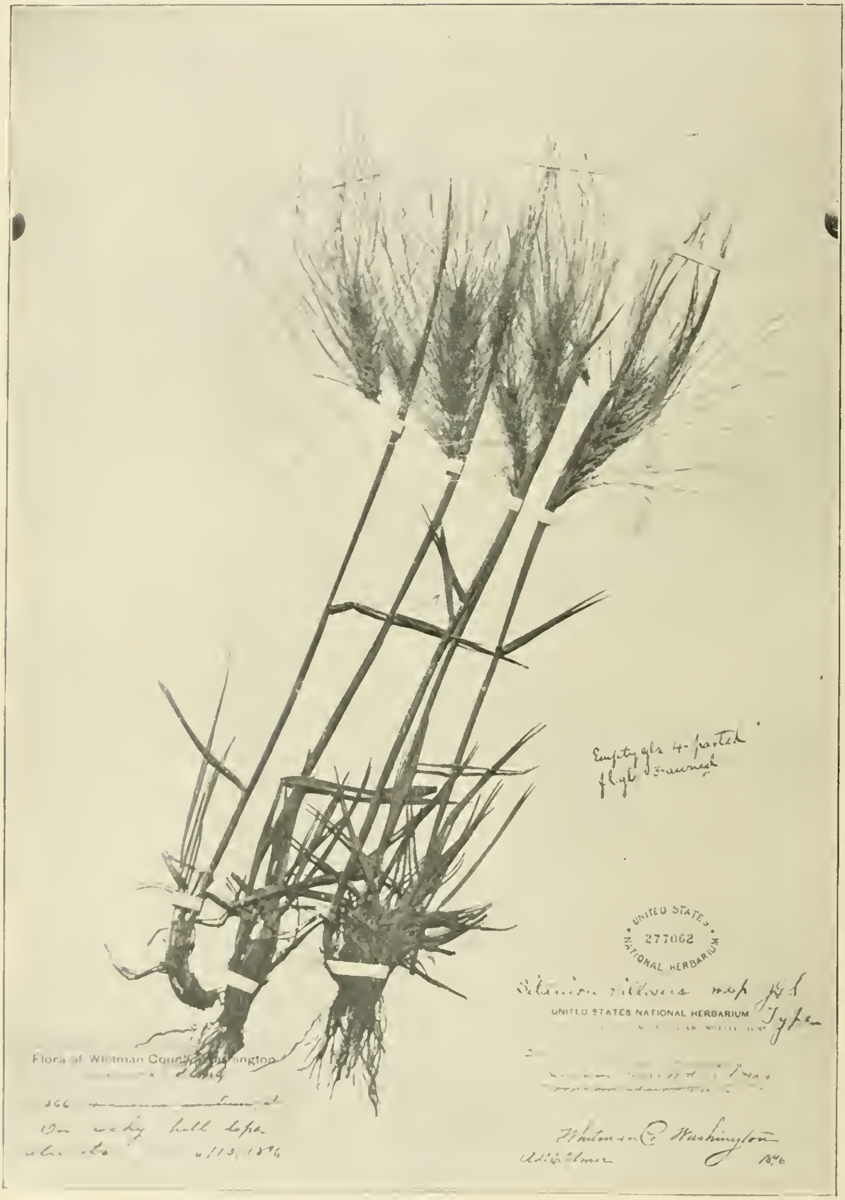
DESCRIPTION OF THE SPECIES.

§ **Polyantherix.** (Nees, as a genus.) *Lowest flowering glume of one or both spikelets sterile, awnlike; empty glumes deeply cleft into from 3 to 11 or more setaceous awns.*

1. SITANION JUBATUM J. G. Smith, sp. nov.

Culms stout, erect, or ascending, 6 to 9 dm. high, robust, terete, smooth. Nodes glabrous. Lower sheaths hirsute, the upper ones minutely pubescent or when young sparsely hirsute, becoming smooth, much exceeding the internodes, open at the throat. Ligule cartilaginous, 1 mm. long. Blade narrowly linear-lanceolate, 10 to 18 cm. long, 3 to 5 mm. wide, rather rigid, flat at the base, involute toward the acuminate apex, strigose-pubescent throughout, sparsely hirsute above and on the back toward the base, finely nerved above, with the midnerve prominent beneath. Spike 1 to 2 dm. long, often more than 1.5 dm. in diameter to the tips of the spreading awns, densely flowered, exserted or the basal portion inclosed in the uppermost leaf sheath. Empty glumes 4, 3- to many-parted from about the middle, the lobes setaceous, from 1 to 10 cm. long. Spikelets 2 at a node, each 2- to 4-flowered, the lowest sterile, the second hermaphrodite, the uppermost staminate or sterile. Flowering glume linear-lanceolate, acute, 8 to 10 mm. long, smooth and shining below, 5-nerved from about the middle, sparsely scabrous above, trifid at the apex, the lateral lobes setaceous, the middle one prolonged into a slender, scabrous, subflexuous awn, 8 to 12 cm. long. Internodes of the rachis 5 to 7 mm. long, compressed or plano-convex, spatulate, glabrous.

Type collected by Robert M. Horner, No. 573, Waitsburg, Wash., May 27, 1897, distributed as "*Elymus sitanion jubatum.*" Also collected by Frank W. Hubby, No. 48, among rocks, Ojai Valley, California, May 7, 1896.


Empty gls 4-parted
fl. gl. 3-awned
UNITED STATES NATIONAL HERBARIUM
277062
Sitanion villosum n. sp. J.G.S.
UNITED STATES NATIONAL HERBARIUM
Type
Whitman Co. Washington
1896
Flora of Whitman County, Washington
266
On rocky hill slopes
1896

SITANION VILLOSUM J. G. Smith. Type.

This grass is the largest and most robust species of *Sitanion*. It belongs to the *S. multisetum* group, differing from all other species in the very large spike and exceptionally long awn of the flowering glume.

2. **SITANION VILLOSUM** J. G. Smith, sp. nov. Pl. I.

Culms stout, erect, or slightly geniculate, 2 to 3 dm. high, densely leafy at the base, forming close, matted tufts. Sheaths rather densely hirsute, the lower strict, the uppermost somewhat inflated, scabrous. Ligule almost obsolete. Blades short, rigid, ascending or divaricate, finely strigose-pubescent and more or less densely hirsute, scabrous along the cartilaginous margins, linear-lanceolate, acuminate, pungently-pointed, 4 to 8 cm. long, about 3 mm. wide, flat, or at length involute. Spike 6 to 8 cm. long, subflexuous, its base inclosed in the greatly elongated uppermost leaf-sheath. Empty glume 3- to 7- or 8-parted from near the base, each lobe a very slender, scabrous, divaricate awn from 2.5 to 8 cm. long. Lowest floret usually sterile, its glume many-parted, like the empty glumes. Perfect florets 1 or 2. Flowering glume about 8 mm. long, obliquely lanceolate, smooth and shining at the base, scabrous for the upper two-thirds, 3-awned, the middle awn rather stout, divergent, 8 to 10 cm. long, the lateral ones very slender, 5 to 10 mm. long Palea as long as the flowering glume, obtuse, acute, or with two short, slender awns at the apex. Internodes of the rachis 4 to 5 mm. long, linear-compressed, glabrous.

Type collected by A. D. E. Elmer, No. 266, on rocky hilltops, Almota, Whitman County, Wash., June 13, 1896; also collected by C. V. Piper, No. 2598, on dry, gravelly prairies, Spokane, June 25, 1897; and Robert M. Horner, No. 574, Waitsburg, Wash., June 3, 1897.

This species may be separated from *Sitanion polyantheris*, to which it is closely related, by the short, rigid, hirsute basal culm leaves.

3. **SITANION MULTISETUM** J. G. Smith, sp. nov.

Culms 3 to 5 dm. high, terete, striate, glabrous or minutely strigose-pubescent, erect or slightly geniculate, much branched from the very base. Sheaths rather loose, open at the throat, scarious along the margins above, strigose-pubescent and hirsute on the back, mostly longer than the internodes. Ligule very short, membranaceous. Blades 5 to 10 cm. long, rigid, erect or ascending, linear, acute and pungently pointed, flat, becoming involute, sparsely hirsute on the back, scabrous on the margins, hirsute and scabrous along the prominent nerves above. Spike erect, 5 to 8 cm. long. Spikelets two at each node but usually only one bearing perfect florets. Empty glumes many-parted nearly to the base, the slender, ascending, scabrous awns varying from 1 to 5 or rarely 8 cm. long. Lowest flowering glume of the sterile spikelet subulate, resembling the segments of the empty glumes, but somewhat lanceolate at the base. Flowering glume of the fertile spikelet about 8 or 9 mm. long, linear-lanceolate, rounded on the back, smooth and shining below, keeled and scabrous above, 3-awned, the middle awn stout, rigid, scabrous, 5 to 6 cm. long, the lateral ones slender, 3 to 8 mm. long. Palea as long as the flowering glume, acute or bicuspidate. Internodes of the rachis compressed, spatulate above, smooth and shining, scabrous along the margins, 4 to 5 mm. long.

Type specimen collected by Coville and Funston, No. 1121, Tehachapi Valley, Kern County, Cal., June 25, 1891. Other specimens which may be referred to this are Samuels, No. 225, Sonoma County, Cal.; a specimen collected by Bolander at San Francisco without date or number; Dr. Palmer, No. 2422, Petaluma, 1892; Hansen, No. 617, Clinton, Amador County, June 30, 1893; a specimen marked "J. A. Allen, California;" and L. Schoenefeldt, No. 3439, Nachoguero Valley, Lower California, June 14, 1894.

It differs from *Sitanion polyantheris* and *S. breviaristatum* in the very much longer and more rigid, erect or ascending awns of the empty glumes, and the leaves hirsute dorsally toward the base and along the nerves above.

4. **SITANION POLYANTHERIX** J. G. Smith, new name. *Polyantherix hystrix* Nees. in Ann. Nat. Hist. **1**: 284 (1838), not *Ægilops hystrix* Nutt.

Culms 3 to 4 dm. high, terete, striate, minutely strigose-pubescent. Sheaths striate, scabrous, closely enveloping the internodes and longer than them, hirsute. Ligule very short, membranaceous. Blades 6 to 25 cm. long, linear, long-attenuate or filiform, involute, acuminate, the lower hirsute on the back, the upper smooth, scabrous and sparsely hirsute on the nerves above. Spike 7 to 10 cm. long, rather rigid and densely flowered. Spikelets 2 at each node; all the florets of one of the spikelets sterile and the lowest and uppermost florets of the other either staminate or sterile, only the second producing seed. Empty glumes 5- to many-parted from near the base, the segments extending into slender, abruptly divaricate awns, 6 to 25 mm. long. Flowering glume of the hermaphrodite floret linear-lanceolate, acute, smooth and shining for its lower two-thirds, slightly seabrous above, with a rigid, scabrous awn 2.5 to 3 cm. long arising from between two minute teeth. Palea a little longer than the flowering glume, acute. Internodes of the rachis very short, smooth and shining, compressed, broadest above, about 3 mm. long.

Type collected by Douglas, in California. There is a specimen in the National Herbarium, labeled *Sitanion polyantherix*, which was collected by Dr. J. M. Bigelow, surgeon and botanist to Lieut. A. W. Whipple's expedition for a railway route from the Mississippi River to the Pacific Ocean, near the thirty-fifth parallel of latitude in 1853–54, California, without locality, and it is from this plant that the above description is drawn.

This species may be separated from *S. breviaristatum*, to which it is related, by the very long-attenuate, filiform leaves, and taller and more slender culms.

5. **SITANION BREVIARISTATUM** J. G. Smith, sp. nov.

Low, caespitose perennial, with slender, erect spikes and very long, rigid, erect or ascending leaves. Culms about 2 dm. high, erect, clothed with dead leaf-sheaths at the base. Sheaths smooth, closely enveloping and longer than the internodes, scarious along the margins. Ligule nearly obsolete. Blades 5 to 15 cm. long, linear, rigid, pungently pointed, densely strigose pubescent on both surfaces, closely involute. Spike slender, rigid, 3 to 6 cm. long. Empty glumes 2- to many-parted, bearing scabrous, flexuous, divergent awns, from 7 to 20 mm. long. Flowering glume about 6 mm. long, narrowly lanceolate, smooth below, scabrous above, tipped with a short, rigid awn from 1 to 1.5 cm. long. Palea as long as the flowering glume, acute, 2-nerved, scarious along the margins, bicuspidate. Grain adherent to the palea, elliptical, oblanceolate, 5 mm. long, compressed, acute at the base, rounded at the apex. Internodes of the rachis compressed, 4 to 5 mm. long, spatulate above, glaucous.

Type specimen collected by Coville and Funston, No. 833, Willow Creek Canyon, Panamint Mountains, California, May 22, 1891.

This species differs from *Sitanion multisetum* to which it is related, in the low, densely caespitose habit; short, slender spikes; and very short awns of the empty and flowering glumes. The bases of the culms are clothed with papery leaf-sheaths.

§§ **Eusitanion.** *Lowest floret of one or both spikelets sterile and like the empty glumes; some of the empty glumes bifid from about the middle, the divisions divergent; the others entire, subulate-setaceous.*

6. **SITANION MINUS** J. G. Smith, sp. nov.

Culms 1.5 to 2 dm. high, slender, rigid, erect, terete, glabrous. Nodes glabrous. Culm leaves 5. Sheaths glabrous, closely enveloping and longer than the internodes. Ligule almost obsolete. Blades 5 to 7 cm., those of the innovations 8 to 12 cm. long, rigid, erect or somewhat divaricate, linear, acuminate, involute, smooth and glabrous on the back, scabrous on the margins, strigose-pubescent on the nerves above. Spikes 3 to 5 cm. long, slender, their bases included in the upper leaf sheaths, closely-flowered. Empty glumes 4, subulate or one of the lateral ones often lanceolate and 2-nerved, bifid from above the middle, scabrous, 25 to 32 mm. long. Spikelets 2-flowered, both florets of one of them sterile, reduced to subulate awns. Lower floret of the other hermaphrodite, the flowering glume 5 mm. long, lanceolate, strongly nerved and scabrous above the middle, smooth below, entire, tipped by a slender scabrous, subflexuous awn about 3 cm. long. Palea as long as the flowering glume, bicuspidate. Second floret rudimentary, awned. Internodes of the rachis 2 to 3 mm. long, spatulate, glabrous.

Type collected by L. Schoenefeldt, No. 3277, International Boundary Commission, Jacumba Hot Springs, near monument 233, altitude 900 m., May 24, 1894.

Related to *Sitanion multisetum.*

7. SITANION RIGIDUM J. G. Smith, sp. nov.

Culms 1 to 2 dm. high, terete, striate. Nodes glabrous. Sheaths longer than the internodes, smooth and glaucous, or the lower ones hirsute, open at the throat. Ligule cartilaginous, 1 mm. long. Blades 3 to 8 cm. long, 2 to 3 mm. wide, rigid, involute, smooth and glaucous on the back, obtuse or acute at the apex, scabrous along the margins and nerves above. Spike 2 to 8 cm. long, ascending, exserted its own length, or the base included in the uppermost leaf-sheath; empty glumes 4 and entire, or 6 (*i. e.*, the two lateral ones at each node divided to the very base) awned, strongly divaricate, 2 to 3 cm. long. Lowest floret sometimes sterile, like the empty glumes. Spikelets few-flowered. Flowering glume 7 to 9 mm. long, linear-lanceolate, trifid, smooth and glaucous below, scabrous above, tipped with a stout, divergent awn 3 to 4 mm. long. Internodes of the rachis 3 to 4 mm. long, compressed, scabrous on the margins.

Type collected by O. D. Allen, No. 178, Cascade Mountains, Washington, 1896. Other specimens examined are Elmer, No. 1145, Washington, 1898; and G. R. Vasey, Washington, 1889; H. E. Brown, No. 372, north side of Mount Shasta, California, 1897; R. M. Horner, No. 579, Blue Mountains, Washington, July 29, 1897; A. Nelson, No. 1021, Union Pass, Wyoming, August 13, 1895; J. N. Rose, No. 271, Timber Reserve, northwest Wyoming, August 28, 1893; Frank Tweedy, No. 79, Teton Forest Reserve, Wyoming, July, 1897; and S. Watson, No. 1337, E. Humboldt Mountains, Nevada, August, 1868.

This grass is related to *S. glabrum*, differing in the dwarf habit of growth and rigid glaucous leaves.

8. SITANION CALIFORNICUM J. G. Smith, sp. nov.

Culms low, ascending, 1.5 to 2.5 dm. high, terete, striate, densely pubescent above, geniculate at the nodes. Sheaths longer than the internodes, the lower ones densely hirsute, the upper minutely puberulent, the uppermost many times longer than the blade. Ligule obsolete. Blade 2 to 8 cm. long, 3 to 4 mm. wide, rigid, divaricate or ascending, prominently striate, linear-lanceolate, abruptly contracted at the base, attenuate toward the obtuse or subacute apex, scabrous above and on the margins, densely puberulent on the back. Spike subflexuous, erect or ascending, loosely few-flowered, 5 to 8 cm. long, barely exserted or the base inclosed in the uppermost leaf-sheaths. Lowest floret of one of each pair of spikelets sterile. Empty glumes 4, entire, subulate-setaceous, divaricate, 3 to 5 cm. long. Flowering glume linear, acute, abruptly rounded at the base, 10 to 12 mm. long, finely scabrous, terminating in a stout, divaricate, scabrous awn about 4 cm. long, arising from between two minute lateral setæ. Palea 2 mm. shorter than the flowering glume, truncate or obtuse, scabrous on the nerves above. Internodes of the rachis compressed, 4 to 5 mm. long, scabrous throughout.

Type collected by S. B. Parish, No. 3295, San Bernardino Mountains, California, altitude 2,150 m., June 23, 1894. Closely related to *S. rigidum*, but with leaves pubescent throughout and longer flowering glumes.

9. **SITANION GLABRUM** J. G. Smith, sp. nov.

Culms erect, terete, smooth and shining, glaucous. Sheaths glaucous, glabrous, rather closely enveloping and shorter than the internodes, scarious along the margins, open at the throat. Ligule membranaceous, almost obsolete. Blades 7 to 15 cm. long, 2 to 5 mm. wide, broadly linear, acute, flat becoming involute, smooth and glabrous on the back, scabrous-pubescent along the nerves above. Spike 5 to 8 cm. long, slender, subflexuous, its base inclosed in the swollen uppermost sheath. Empty glumes bifid from the very base, the lobes subulate, setaceous, 6 to 8 cm. long, subflexuous, slender, divaricate. Flowering glume 7 to 8 mm. long, rounded on the back, smooth and shining for its lower two-thirds, linear-lanceolate, acute, entire or minutely bifid at the apex, tipped with a slender, rigid, setaceous awn 4 to 5 cm. long. Palea as long as the flowering glume, bidentate, scabrous on the nerves above. Internodes of the rachis obcuneate, compressed, about 3 mm. long.

Type collected by Coville and Funston, No. 914, near Crystal Spring, Coso Mountains, California, June 12, 1891. Also collected by J. A. Allen, California, without date or locality. No. 821, Hall, San Jacinto Mountains, may be placed here; and also Purpus, No. 5289, Pah Mountains, 1897. The latter has the habit of typical *S. glabrum*, but the leaves and sheaths are minutely soft pubescent and the spikelets and empty glumes purplish. Other specimens examined are: L. Schoenefeldt, No. 3609, Laguna, Cal., June 14, 1894; and C. V. Piper, No. 1952, dry slopes Mount Rainier, Wash. 2,100 m., August, 1895.

10. **SITANION INSULARE** J. G. Smith, sp. nov.

Culms slender, erect, terete, glabrous. Nodes glabrous. Culm leaves 4 or 5. Sheaths glabrous, closely enveloping the culm, open at the throat, shorter than the internodes. Ligule almost obsolete. Blades linear, 1 to 1.5 dm. long, glabrous on the back, strongly nerved and strigose-pubescent on the nerves above, scabrous along the margins. Spike slender, 5 to 8 cm. long. Empty glumes lanceolate, bifid and 2-awned, 4 to 5 mm. long, 2 mm. wide, tipped with divergent, slender, scabrous awns, 10 to 20 mm. long. Flowering glume 8 mm. long, linear-lanceolate, smooth and shining, glabrous for the lower two-thirds, rounded on the back below, keeled above, 3-toothed, the middle nerve extending into a stout, scabrous, divaricate awn about 15 mm. long; lateral teeth 1 to 2 mm. long. Palea as long as the flowering glume, 2-toothed at the apex. Internodes of the rachis linear, dilated above, sharply 2-edged, scabrous on the margins, 7 to 10 mm. long.

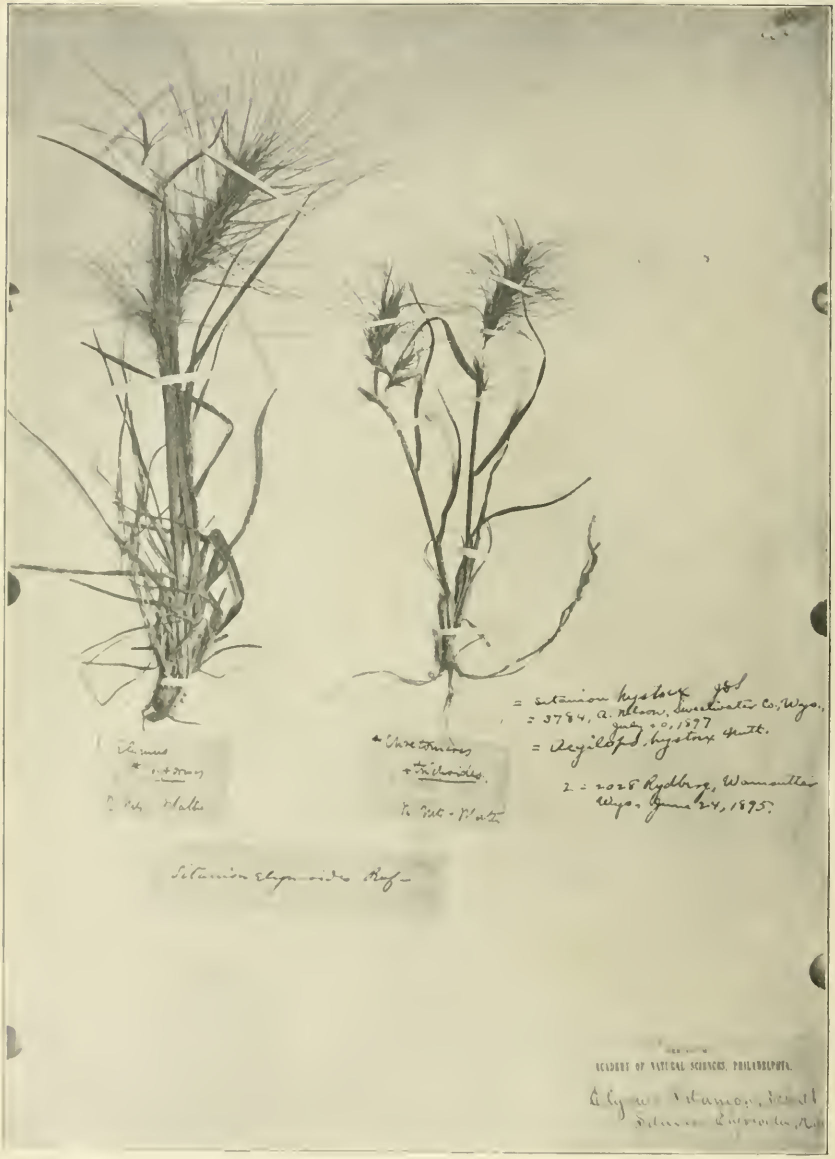
Type collected by Sereno Watson, No. 1338, Carrington Island, Salt Lake, Utah, June, 1869.

This species is quite distinct from any other in the National Herbarium. It has the broad empty glumes of *Elymus*, but two-parted, as in *Eusitanion*, with divaricate awns. The empty glumes are inserted as in *Sitanion*, while the form of the spikelets and the habitat of the inflorescence resembles some species of *Agropyron*. As in the other *Sitanion* species the rachis breaks up into segments at maturity.

11. **SITANION CINEREUM** J. G. Smith, sp. nov.

Slender, ascending, leafy perennial, 2 to 3 dm. high, the entire plant ashy-gray with a close, dense pubescence. Innovations as long as the culms. Culms slender, terete, pubescent. Nodes glabrous. Sheaths closely enveloping the internodes and shorter than them, densely ciliate-pubescent. Ligule almost obsolete. Blades linear, rigid, involute, the uppermost 5 to 7, the lower 15 to 20 cm. long, densely strigose-pubescent on the nerves above, soft-pubescent or hirsute below. Spike slender, 4 to 5 cm. long. Empty glumes very scabrous, bifid, 2-awned, the strongly divergent scabrous awns 2 to 3 cm. long. Flowering glumes 7 to 8 mm. long, rounded on the back, scabrous throughout, 3-nerved toward the apex, 3-awned, the lateral awns very slender, 2 to 4 mm. long, the middle one stout,

PLATE II.


= Sitanion hystrix J.G.S.
= 3784, A. Nelson, Sweetwater Co., Wyo., July 20, 1897
= Aegilops hystrix Nutt.
2 = 2028 Rydberg, Wamsutter Wyo., June 24, 1895.
Sitanion Elymoides Raf.
ACADEMY OF NATURAL SCIENCES, PHILADELPHIA.

SITANION HYSTRIX (Nutt.) J. G. Smith.

Photograph of Nuttall's type in the Herbarium of the Philadelphia Academy of Science divaricate, 2 to 3 cm. long. Palea as long as the flowering glume, tipped with two slender scabrous awns. Internodes of the rachis scabrous along the margins; 2 to 4 mm. long.

Type collected by S. M. Tracy, No. 222, Reno, Nev., 1887.

It differs from any other specimen in the National Herbarium in being densely grayish-pubescent throughout. In the character of the spikelets it approaches *S. hystrix*. No. 127, Suksdorf, Bickleton, Yakima County, Wash., June 7, 1884, with similar leaves and inflorescences, but the plant less densely pubescent and quite glaucous, may be placed here. Also a specimen collected by Dr. C. H. Merriam on Mount Shasta, California, 1898.

12. **SITANION HYSTRIX** (Nutt.) J. G. Smith, new combination. (*Ægilops hystrix* Nutt. Gen. N. Am. Pl., **1**: 86, 1818.) Pl. II.

Culms 1 to 3 dm. high, slender, erect or ascending, scabrous above, clothed at the base with papery leaf-sheaths. Innovations very leafy, one-third to two-thirds the length of the culms. Sheaths striate, strigose-pubescent, open at the throat, closely enveloping the internodes. Ligule almost obsolete. Blades narrowly linear, flat or at length involute, strigose-pubescent throughout, prominently 9-nerved, scabrous along the margins, erect or ascending; those of the innovations 7 to 12 cm. long, 1 to 2 mm. wide; culm leaves about as long, 2 to 4 mm. wide. Spike 5 to 7 cm. long, erect or subflexuous, exserted, or its basal portion inclosed in the uppermost leaf-sheath, closely flowered. Spikelets 3- to 4-flowered, compressed. Empty glumes bifid, from near the base and unequally 2-awned; the strongly scabrous, glaucous, divergent awns, 3 to 4 cm. long. Flowering glume 7 to 8 mm. long, linear-lanceolate, minutely pubescent, 3-awned, the middle awn rather slender, recurved, about 3 cm. long. Palea as long as or longer than the flowering glume, scabrous, tipped with two slender awns, 2 to 3 mm. long. Internodes of the rachis glaucous, linear, not at all dilated above, about 5 mm. long.

A common, worthless bunch grass on shale hills and among the sagebrush on the high plains from western Colorado to eastern Washington.

Specimens examined: *Wyoming:* P. A. Rydberg, No. 2028, Wamsutter, July 24, 1895; C. L. Shear, No. 280½, Wamsutter, June 24, 1895; No. 283, Green River, June 25, 1895; Thomas A. Williams, No. 2437, dry rocky hillsides, Evanston, July 10, 1897; No. 2379, dry sagebrush hills, Green River, July 9, 1897; Aven Nelson, No. 3058, Green River Hills, May 31, 1897; No. 3669, Wamsutter, July 10, 1897; No. 3784, North Vermilion Creek, July 20, 1897.

Washington: C. V. Piper, No. 2579, on sagebrush land, Ellensburg, July 9, 1897. A. B. Leckenby, Walla Walla, July 12, 1898.

Colorado: John Wolfe, No. 623, 1873; C. Thomas, 1869; and F. E. Clements, No. 60, Walsenburg, July 10, 1896.

There are in the herbarium of the Philadelphia Academy of Science two of Nuttall's specimens of *Sitanion*. One of these, labeled "*Chætomeris trichoides*, R. Mts. Platte," is exactly identical with No. 3784, A. Nelson, and No. 283, C. L. Shear, both collected in the Red Desert of Wyoming. The other, labeled "*Elymus difformis*, R. Mts. Platte," is nearly identical with No. 2028, Rydberg, from Wamsutter, Wyo. If these specimens are those from which Nuttall's description of *Ægilops hystrix* was drawn, and they agree better with his description than any specimen from the "arid plains of the Missouri" so far examined, then there was undoubtedly a mistake made in referring the habitat of this to that locality.

I am assured by Dr. E. L. Greene that it is highly improbable that Rafinesque drew his description of *S. elymoides* from Nuttall's plant, and it is certain that Rafinesque's description (Journ. Phys. **89**: 1819) differs in important particulars from that of *Ægilops hystrix*, Nuttall. I am, however, unable definitely to identify any *Sitanion* with which I am familiar as the true *S. elymoides*, Raf. The locality, "Missouri," of 1819, was then applied to what now constitutes several large

States in which a dozen or more separate species occur. Rafinesque apparently left no type, and the original description is too fragmentary to enable one to more than guess at the identity of the plant which he described.

13. SITANION CÆSPITOSUM J. G. Smith, sp. nov.

Densely cæspitose, with flat leaves, and weak, ascending culms. Sterile shoots very leafy, erect or spreading, 1 to 2 dm. long. Culms 2 to 3 dm. high, very slender, terete, glabrous. Nodes glabrous. Sheaths striate, open at the throat, smooth and glabrous. Ligule membranaceous, entire, very short. Blades 4 to 10 cm. long, 2 to 3 mm. wide, linear, flat, or the margins incurved, prominently 7-nerved above, glabrous on the back, scabrous above. Spike 4 to 6 cm. long, its base sometimes inclosed in the uppermost sheath, mostly exserted, somewhat flexuous. Empty glumes entire or bifid, 3 to 4 cm. long, divaricate, scabrous. Flowering glume of the lowest fertile floret linear-lanceolate, entire, smooth and shining below, sparsely scabrous above the middle, about 7 mm. long, tipped with a flexuous scabrous awn, about 5 mm. long. Callus rounded, glabrous. Palea as long as the flowering glume, rounded at the apex. Joints of the rachis glabrous, except along the margins, not at all dilated above, two-thirds the length of the lowest floret.

Growing in rich soil in the canyons around Silver City, N. Mex.

Type specimens collected by Jared G. Smith, near Cliff, N. Mex., August 19, 1897. Also collected at the same locality in August, 1896. It grows only in shaded canyons, and on moist talus slopes in the mountains at an altitude of about 2,000 m. Its leaves continue green during the winter. It is one of the "mutton grasses," formerly abundant and highly valued as forage for sheep and cattle, now to be found only in protected situations. Probably also occurring in the mountains of western Texas, although there are no specimens from any other locality than the typical one in the National Herbarium.

Closely related to *S. hystrix* (Nutt.) JGS., but the sheaths and blades are glabrous on the back.

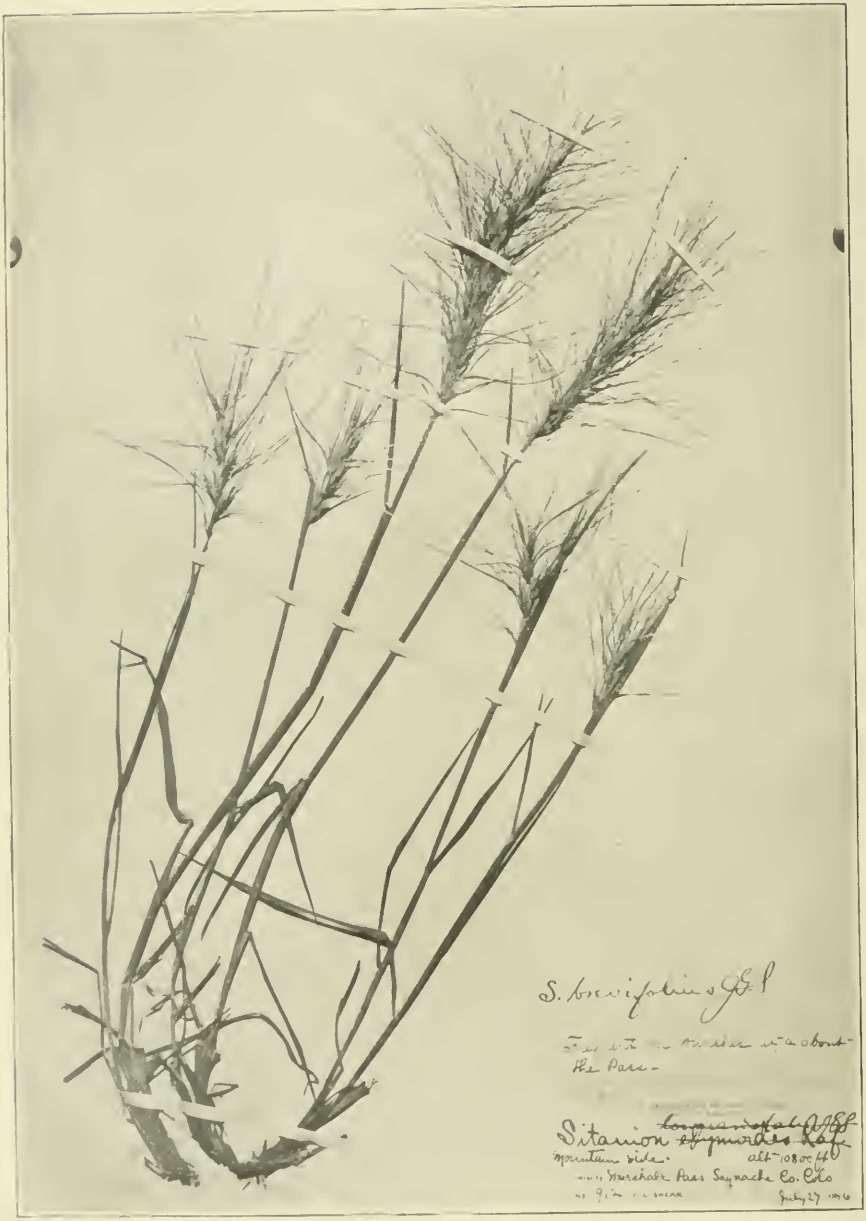
14. SITANION MONTANUM J. G. Smith, sp. nov.

Culms rather stout, erect, 2 to 4 dm. high, terete, striate, glabrous below, scabrous above. Sheaths rather loose, open at the throat, as long as, or longer than, the internodes, smooth, scabrous or pubescent. Blades 5 to 10 cm. long, 3 to 4 mm. wide, linear, acuminate, flat or involute, pubescent on the back, scabrous or strigose-pubescent on the prominent nerves above, scabrous along the margins, rigid, erect or ascending, the uppermost usually shorter than the spike. Spike erect, loosely flowered, 5 to 10 cm. long. Empty glumes subulate, scabrous, long-awned, some of those in the lower part of the spike unequally bifid, the lobes extending into scabrous, divergent awns 5 to 6 cm. long, 2 or often 3 spikelets at each node. Lowest floret sterile. Flowering glumes 10 to 11 mm. long, linear-lanceolate, rounded on the back, smooth and shining for the lower third, scabrous above and on the margins, trifid, three-awned, the scabrous, divergent middle awn 4 to 7 cm. long, the lateral awns very short, slender. Palea as long as the flowering glume, with two short, setaceous, scabrous awns, or sometimes rather obtuse and muticous. Internodes of the rachis linear or dilated above, compressed, glaucous, 4 to 6 mm. long.

S. montanum differs from *S. strigosum* in the shorter, flat, and more rigid erect leaves and smoother flowering glume. This may be Rafinesque's *S. elymoides.*

Northern Wyoming and Montana to Oregon. SPECIMENS EXAMINED: *Montana:* F. Lamson-Scribner, No. 137, gravelly bottoms, Indian Creek, July 4, 1883; rather densely cinereous-pubescent throughout. P. A. Rydberg, No. 3091 (type), Spanish Creek, July 15, 1896; and No. 3133, Spanish Basin, July 18, 1896. Thomas A. Williams, No. 2002, Spanish Creek Basin, July 16, 1896, on sterile, rocky soil.

Wyoming: Thomas A. Williams, No. 2776, Bull Camp, August 2, 1897; and No. 2596, Ten Sleep Lakes, Big Horn Mountains, August 19, 1897.


S. brevifolius J.G.S.
the Pass.
Sitanion ~~elymoides Raf.~~
mountain side. alt 10800 ft
Marshall Pass Saguache Co. Colo
July 27 1896

SITANION BREVIFOLIUM J. G. Smith. Typical.

Idaho: B. W. Everman, No. 319, shores of Petit Lake, August 13, 1895.

Oregon: A fragmentary specimen collected by the U. S. South Pacific Exploring Expedition, under the command of Captain Wilkes, 1838-1842, is doubtfully referred here.

15. **SITANION STRIGOSUM** J. G. Smith, sp. nov.

Culms stout, erect, 3 to 6 dm. high, terete. striate, glabrous, the uppermost internodes minutely pubescent. Nodes brownish, glabrous. Sheaths open at the throat, loose, striate, scarious along the margins above, more or less densely pubescent, as long as or longer than the internodes. Ligule nearly obsolete. Blades 1 to 2.3 dm. long, 3 to 6 mm. wide, linear to linear-lanceolate, flat or the lower ones involute, rounded at the base, long-acuminate pointed, strongly nerved, strigose-pubescent throughout, sparsely hirsute along the nerves, scabrous on the cartilaginous margins. Spike stout, erect, exserted, 8 to 12 cm. long. Empty glumes with the awn 5 to 6 cm. long, entire or bifid, scabrous, long-awned, divaricate. Flowering glumes 8 to 10 mm. long, lanceolate, rounded on the back, scabrous and glaucous, strongly 3-nerved above, the middle awn stout, recurved, scabrous, 5 to 7 cm. long, the lateral ones 1 to 2 mm. long. Palea nearly as long as the flowering glume; bifid, with two short awns, ciliate along the nerves above.

Type collected by P. A. Rydberg, No. 3298, Sheep Creek, Montana, August 8, 1896. Also collected by Charles A. Geyer, June 10, 1839, "in heavy ferruginous loam, Missouri, James and Shienne River valleys," probably at the eastern border of the Bad Lands, above Mandan, N. Dak.

S. strigosum differs from *S. montanum* in the very long, less rigid, more strongly nerved culm leaves, the uppermost nearly as long as or much exceeding the spike, those of the innovations half the length of the culm. The flowering glumes are more scabrous and shorter. This may be Rafinesque's *S. elymoides.*

16. **SITANION MOLLE** J. G. Smith, sp. nov.

Culms stout, erect, rigid, 3 to 4 dm. high, clothed at the base with dead leaf-sheaths, terete, striate, pubescent. Innovations about half as long as the culm. Nodes glabrous. Sheaths rather loose, open at the throat, longer than the internodes, pubescent, the lower ones sparsely hirsute along the nerves, the upper puberulent and scabrous on the nerves. Ligule entire, almost obsolete. Blades rigid, erect or ascending, linear, long-acuminate pointed, 8 to 15 cm. long, 3 to 5 mm. wide, the uppermost longer than the spike, soft-pubescent throughout, scabrous along the cartilaginous margins, on the nerves above and along the midrib beneath. Spike 7 to 8 cm. long, erect, loosely flowered, shortly exserted. Empty glumes 4, entire or unequally bifid, subulate-setaceous, 6 to 7.5 cm. long, scabrous, divaricate. Lowest floret of one of the spikelets sterile and like the empty glumes. Flowering glume of the lowest hermaphrodite floret linear-lanceolate, acute, 1 cm. long, smooth and shining, glaucous, trifid, or entire, tipped with a stout, spreading, scabrous awn 5 to 7 cm. long. Palea as long as the flowering glume, acute, or bicuspidate scabrous along the nerves.

Type collected by Shear and Bessey, No. 1469, East Side Buffalo Pass, Larimer County, Colo., moist, open mountain side, 3,200 m. August 14, 1898.

S. molle is related to *S. montanum.* It differs in being finely pubescent throughout. The leaves are longer and less strongly nerved.

§§§ **Hordeiformae.** *Lowest floret hermaphrodite. Empty glumes 4, entire.*

17. **SITANION BREVIFOLIUM** J. G. Smith, sp. nov. Pl. III.

Culms 3 to 6 dm. high, terete, stout, erect, obscurely striate, glaucous. Innovations less than half the length of the culms. Nodes glabrous. Sheaths smooth, scarious along the margins, glaucous, longer than the internodes, the uppermost much elongated, the lower sometimes pubescent or hirsute. Ligule almost obsolete. Blades 5 to 10 or rarely 12 cm. long, 3 to 4 mm. wide, linear, acuminate, flat or involute, rigid, divergent or ascending, smooth and glaucous on the back, scabrous-pubescent along the prominent nerves above. Spike 7 to 15 cm. long, loosely few-flowered, long-exserted. Empty glumes stout, setaceous, divergent, 5 to 9 cm. long, smooth and shining and often glaucous at the base, scabrous above. Flowering glumes 8 to 10 mm. long, linear-lanceolate, glaucous, scabrous throughout, rounded on the back below, nerved above, entire, tipped with a stout, scabrous, spreading awn 4 to 8 cm. long. Palea as long as the flowering glume, scabrous on the margins above, obtuse. Joints of the rachis compressed, glaucous, 5 to 10 mm. long, linear. Closely related to *S. longifolium*, but the culm leaves shorter and more rigid and the innovations less than half as long as the culms.

Type collected by J. W. Toumey, No. 797, Tucson, Ariz., 1892.

Specimens examined, *Colorado:* Tracy, Earle & Baker, No. 4274, Hamors Lake, July 24, 1898; No. 429, Mancas, July 8, 1898; No. 4272, Durango, July 18, 1898. C. L. Shear, No. 1087, Breckenridge, August 29, 1896; No. 1070, Dillon, August 26, 1896; No. 612, Georgetown, August 17, 1896; No. 997, Westcliffe, August 12, 1896; No. 912, Marshall Pass, July 27, 1896; No. 1003, Buena Vista, August 15, 1896; No. 814 and 833, Veta Pass, July 13, 1896; No. 1096, Como, September 1, 1896; No. 1240, Animas Canyon, August 5, 1897. P. A. Rydberg, No. 2414, Georgetown, August 20, 1895; No. 2509, Boulder, September 3, 1895. Shear & Bessey, No. 1407, Egeria Park, August 4, 1898. Patterson, Georgetown, 1875.

Wyoming: Thomas A. Williams, No. 2573*a*, Iron Mountain, July 2, 1897, and No. 2621, Bear Lodge, July 23, 1897; A. Nelson, No. 3952, Albany County, August 9, 1897.

Utah: Marcus E. Jones, No. 5663*bd*, Marvine Laceolite, July 23, 1894; No. 5684*bb*, Mount Ellen, Henry Mountains, July 25, 1894, and 5770*p*, Fish Lake, August 7, 1894.

18. **SITANION LONGIFOLIUM** J. G. Smith, sp. nov.

Culms 3 to 5 dm. high, stout, ascending, somewhat geniculate at the base, glaucous. Leaves of the innovations 1.5 to 3 dm. long, attenuate, involute, often as long as the culms. Nodes glabrous. Sheaths scabrous and glaucous, or more or less strigose-pubescent, or sparsely hirsute, longer than the internodes, loose, open at the throat, scarious along the margins above. Ligule entire, almost obsolete. Blades linear, long, attenuate, acuminate, striate, smooth and glaucous or pubescent, or sparsely hirsute on the back, 1 to 2 dm. long, 1 to 3 or 4 mm. wide. Spike subflexuous or somewhat nodding, 1 to 1.3 dm. long, rather loosely flowered, its base inclosed in the inflated uppermost leaf-sheath. Spikelets 2 or rarely 3 at each node. Empty glumes subulate setaceous, divaricate, scabrous, 6 to 8 cm. long. Flowering glumes 8 to 11 mm. long, scabrous, glaucous, rounded on the back below, keeled above, entire or minutely trifid, tipped with a stout, scabrous divaricate awn 5 to 6.5 cm. long. Palea as long as the flowering glume, obtuse or bicuspidate, scabrous on the nerves above. Internodes of the rachis compressed, glaucous, 6 to 8 mm. long. Closely related to *S. brevifolium*, from which it may be distinguished by the long attenuate flexuous leaves of the culms and innovations and by the subflexuous spikes, inclosed at the base in the uppermost leaf-sheaths.

Type collected by C. L. Shear, No. 1213, near Silverton, Colo., August 4, 1897, among rocks on the open sides of a canyon, altitude 3,000 m.

Specimens examined, *Colorado:* J. Wolfe, No. 1161–2–3, Denver, 1873. C. L. Shear, No. 1152 and No. 1158, Ouray, July 4, 1897; No. 886, Villa Grove, July 24, 1897; No. 836, Veta Pass, July 15, 1896; No. 717, Idaho Springs, August 27, 1895. M. E. Jones, No. 531, Idaho Springs, August 1, 1878. Tracy, Earle & Baker, No. 4275, Chicken Creek, July 6, 1898. P. A. Rydberg, No. 2497, Idaho Springs, August 28, 1895.

Kansas: C. H. Thompson, No. 21, Ulysses, June 26, 1893.

Wyoming: D. Griffiths, Nos. 493 and 500, Sundance, August 10, 1897; No. 576, Little Missouri Buttes, August 15, 1897; No. 669, Inyankara Mountain, August 23, 1897; A. Nelson, No. 1602, Laramie Peak, August 6, 1895.

Nevada: Shockley, without date or locality.

Arizona: Dr. Palmer, No. 534, 1876. G. C. Nealley, No. 171, Rincon Mountains, August, 1891.

New Mexico: C. Wright, No. 2076, in part, 1851–52. E. O. Wooten, No. 322, White Mountains, August 12, 1897.

Texas: J. Reverchon, Upper Concho River (Curtiss, No. 3536).

19. **SITANION PUBIFLORUM** J. G. Smith, sp. nov.

Low, cæspitose perennial, with stout, rigid, erect culms, 2 to 3 dm. high, and tufted, erect, rigid innovations, 1 to 1.5 dm. long. Culms terete, strigose-pubescent above. Culm leaves 3 to 5. Nodes glabrous, glaucous. Sheaths about as long as, or longer than, the internodes, open at the throat, not at all inflated, glabrous. Ligule obsolete. Blades puberulent on the back, rigid, linear-involute, pungently-pointed, scabrous above, the lowest 10 cm., the uppermost 1.5 to 4 cm. long and horizontally spreading or divaricate. Spike exserted, erect, about 5 cm. long. Empty glumes setaceous, divaricate, 4 to 6 cm. long, scabrous throughout, not at all lobed or divided. Spikelets 2½-flowered, the uppermost floret rudimentary. Flowering glume of the lowest floret 7 mm. long, linear-lanceolate, acute, with a rounded callus, scabrous and finely pubescent, tipped with a straight, erect, scabrous awn, 5 to 6 cm. long. Palea rounded or entire at the apex, as long as the flowering glume, scabrous along the margins. Joints of the rachis one-half to two-thirds as long as the lowest floret, dilated above, scabrous.

Arizona, New Mexico, and southeastern Colorado: Type No. 795, J. W. Toumey, Tucson, Ariz., 1892. Other specimens of this are No. 38, Toumey, south of Ashfork, Ariz., June 25, 1892; C. R. Orcutt, No. 2533, Congress, Ariz., April 21, 1896. A specimen from the Moqui country without data. A. A. & E. G. Heller, No. 3558, Santa Fe, N. Mex., May 21, 1897. C. S. Crandall, No. 535, Trinidad, Colo., May 13, 1892.

This species is distinguished from *S. brevifolium* by the rigid, convolute, erect, puberulent leaves, densely tufted at the base of the low culms, erect spikes, and smaller pubescent flowering glumes.

§§§§**Elymoides.** *Empty glumes lanceolate, 2–5-nerved, entire or lobed, lowest floret hermaphrodite; spikelets 1 or 2 at a node, when 1, the empty glumes inclosing the spikelet as in Elymus and Agropyron; rachis of the spike articulate at the nodes.*

20. **SITANION PLANIFOLIUM** J. G. Smith, sp. nov.

Culms stout, erect, 5 to 6 dm. high, the lower internodes smooth and shining, glaucous, terete, the uppermost slightly striate, glabrous. Sheaths striate, glaucous, open at the throat, loose. Ligule obsolete. Blades 8 to 15 cm. long, 5 to 8 mm. wide, flat, lanceolate, becoming involute toward the acuminate apex, scabrous above, and along the cartilaginous margins, glabrous on the back, more strongly nerved below than above. Spike erect or somewhat nodding, 6 to 9 cm. long, purplish, long-exserted. Spikelets subcylindrical, compressed. Empty glumes 6 to 7 mm. long, lanceolate, strongly 1- to 3-nerved, entire or bifid, glaucous at the base, strongly scabrous on the nerves above, tipped with a slender, spreading, scabrous awn, about 2 cm. long. Flowering glume 10 to 11 mm. long, lanceolate, flat or rounded on the back, glaucous, sparsely and minutely scabrous, bearing a stout, scabrous awn 3 to 4 cm. long. Palea as long as, or slightly longer than, the flowering glume, glaucous, scabrous, obtuse at the apex. Joints of the rachis linear, compressed, dilated above, glaucous, 5 mm. long, very sharply 2-edged, scabrous on the margins.

Type collected by W. N. Suksdorf, No. 224, high mountains, Skamania County, Wash., August 10, 1896.

Closely related to *S. lanceolatum*, from which it differs in the glaucous sheaths and culms, flat, lanceolate leaves which are very smooth on the back, and the purplish, long-exserted spikes with glaucous florets.

21. **SITANION LANCEOLATUM** J. G. Smith, sp. nov.

Culms 2.5 to 5 dm. high, erect or ascending, and somewhat geniculate at the lower nodes. Culms terete, smooth and ascending, striate above. Nodes glabrous. Sheaths glabrous, striate, closely enveloping the culms, longer than the internodes. Ligule almost obsolete. Blades 8 to 15 cm. long, 2 to 3 mm. wide, rather rigid, linear, erect, or the basal ones divergent, flat or convolute, glabrous on the back, scabrous on the margins and nerves above. Spike erect, 6 to 10 cm. long, barely exserted, or its base included in the uppermost leaf-sheath. Spikelets cylindrical, subcompressed, the florets closely overlapping one another. Empty glumes 5 to 6 mm. long, keeled, lanceolate, 2-nerved, oblique, scarious on the margins, entire or unequally 2-awned, the longer awn scabrous, divergent, 10 to 15 mm. long. Flowering glume 8 to 9 mm. long, glaucous, rounded on the back, lanceolate, entire, or minutely 3-toothed at the apex, with a stout, scabrous, divergent awn 2 to 4 cm. long. Palea as long as its glume, obtuse or emarginate, scabrous on the margins above. Joints of the rachis, 5 to 7 mm. long, linear, spatulate, compressed, scabrous on the margins.

Type collected by P. A. Rydberg, No. 3381, Barker, Mont., August 17, 1896.

The habit of this grass resembles that of *Agropyron caninoides* Beal; the spikelets and empty glumes are arranged as in *Elymus*, but the nervation of the empty glumes, trifid flowering glume, and the rachis dehiscent at the nodes, are sufficient characters to throw this species into *Sitanion*.

22. **SITANION HANSENI** (Scribn.) J. G. Smith, nom. nov. *Elymus hanseni* Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: p. 56. 1898.

"A rather stout, glabrous perennial, 9 to 12 dm. high, with narrow, spreading leaves and slender fragile spikes 5 to 8 cm. long. Sheaths smooth, striate. Ligule very short, hardly 1 mm. in length, entire. Leaf-blades 10 to 30 cm. long, 2 to 5 mm. wide. Internodes of the rachis about 1 cm. long. Spikelets 3- to 5-flowered, about 1.5 cm. long, exclusive of the awns. Empty glumes lanceolate, strongly nerved, tipped with 2, sometimes 3, unequal awns, the longer about 3.5 cm. First flowering glume 10 to 12 mm. long, entire or 2-toothed at the apex, terminating in a straight or very slender awn about 5 cm. long. Palea about the length of the glume, minutely scabrous on the sharp keels except at the base, slightly pubescent at the truncate or 2-toothed apex."

Amador County, Cal.

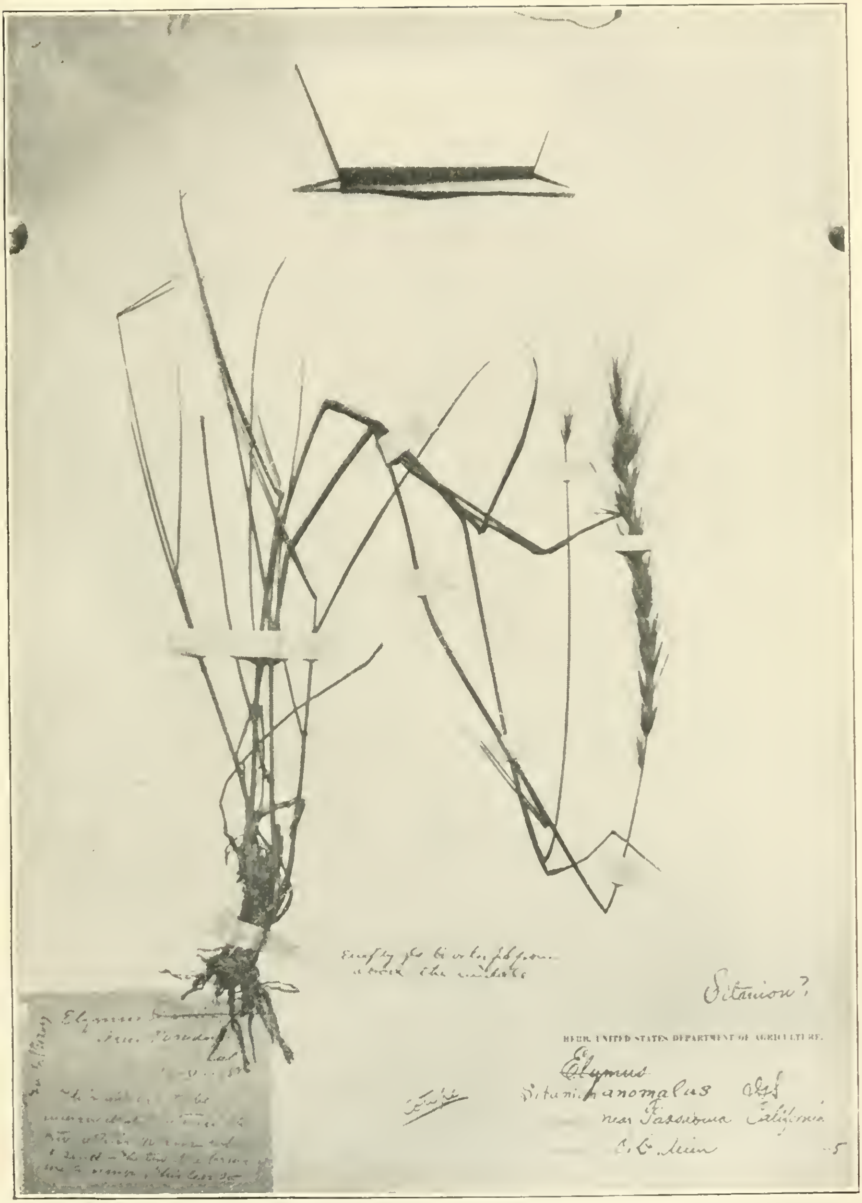
Related to *S. anomalum*, but taller and more slender, with mostly single rather remote spikelets, which are longer.

23. **SITANION ANOMALUM** J. G. Smith, sp. nov. (Pl. IV).

Culms erect or ascending, 5 to 6 dm. high, terete, smooth. Nodes glabrous. Sheaths smooth or the lower sparsely hirsute, ciliate along the margins, shorter than the internodes. Ligule membranous, 1 mm. long. Blades 4 to 12 cm. long, 3 to 4 mm. wide, involute, rigid, linear, long-attenuate, scabrous throughout. Inflorescence simple or thyrsiform, 1 to 1.5 dm. long, few-flowered, interrupted below, subflexuous. Spikelets compressed, 4-flowered, the florets distant. Empty glumes mostly lanceolate, entire, but those of the lowermost spikelets bifid above the middle, with short, scabrous, divergent awns 1 to 4 cm. long. Flowering glumes 1 cm. long, narrowly linear-lanceolate, rounded on the back, smooth below, scabrous above the middle, 3-aristate, lateral awns 1 to 2 mm. long, the middle one straight, erect, scabrous, 3 to 4.5 cm. long. Palea shorter than the flowering glume, obtuse, erose, or bidentate, scabrous along the margins and on the nerves. Internodes of the rachis 7 to 10 mm. long, ancipital, scabrous on the margins.

Type collected by O. D. Allen, near Pasadena, Cal., May 12, 1885. This grass is intermediate between true *Sitanion* and true *Elymus*. The habit is that of *Elymus*, but the articulate rachis, occasionally bifid empty glumes and trifid flowering glumes, indicate a close relationship with *Sitanion*.

DOUBTFUL SPECIES. *Sitanion elymoides* Raf.


Sitanion?
HERB. UNITED STATES DEPARTMENT OF AGRICULTURE.
~~Elymus~~
Sitanion anomalus
near Pasadena California

SITANION ANOMALUM J. G. Smith. Cotype.

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